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Some Operating Features of the Pfister & Vogel Plant

TURBINE PLANT FOR FACTORY SHOWS REMARKABLE ECONOMY; SUCCESSFUL SPENT TAN BARK FURNACE

PRIOR TO 1909 the Menomonee Plant of the Pfister & Vogel Leather Co., located in Milwaukee, was furnished with power by reciprocating engines and belted generators. The output of the factory increased and conditions became such that a new power plant was the best solution. Under the directions of C. P. Bossert, mechanical engineer of the company, the new plant was planned and resulted in such excellent economy that a description of the distinctive features of the plant and its operation is given here as an example for others in similar plants.

Located on the bank of the Menomonee River, conditions are excellent for condensing so the generating units in the plant are turbine driven. The power plant is as near the center of the load as it was practical to locate it and covers an area of 62 by 125 ft. Economy of space was a necessity requiring a choice of equipment

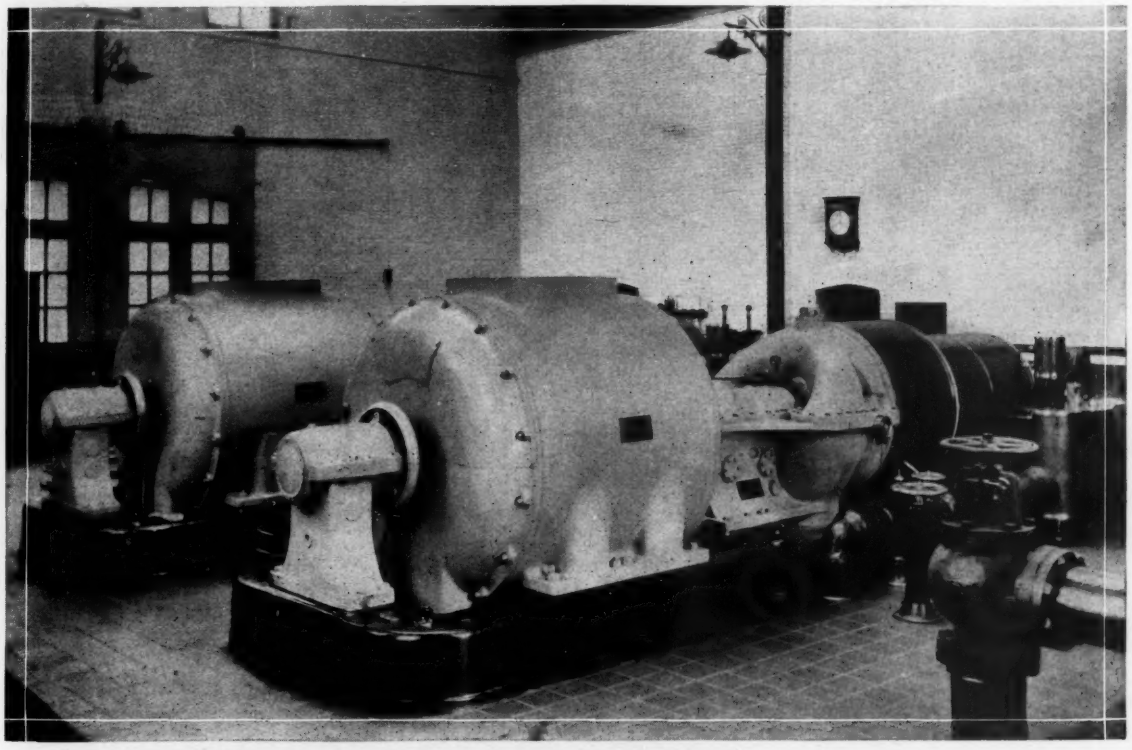


FIG. 3. LARGE GENERATING UNITS

put into operation in 1909. Since this plant was first started, several important additions have been made to the equipment, and the management of the plant has which takes up a small amount of room, even making it necessary to locate the chimney in the building. The plant furnishes electricity for all light and power in

the factory, steam heat for general heating, as well as for various processes in the manufacture of leather and soft water for process work.

Boiler Room

In the boiler room are 6 Edge Moor water-tube boilers of standard 3-pass construction, placed in 2 facing rows and rated at 585 hp. each; they develop steam at 160 lb. with superheat of 100 deg., being equipped with Foster superheaters placed between the first and second passes.

The boilers are served by Green chain grates 12 ft. wide by 10 ft. deep, placed in dutch ovens extending in front of the boilers. Coal used in the plant is Youghiogheny screenings which is delivered in drop bottom cars and dumped into the feed hopper of a coal crusher. From the crusher a bucket elevator carries the coal to an 800-ton bunker over the boilers. The bunker is of steel with a concrete lining and the coal is distributed in the bunker by a scraper conveyor.

Beneath the bunker a 6-ton traveling and weighing

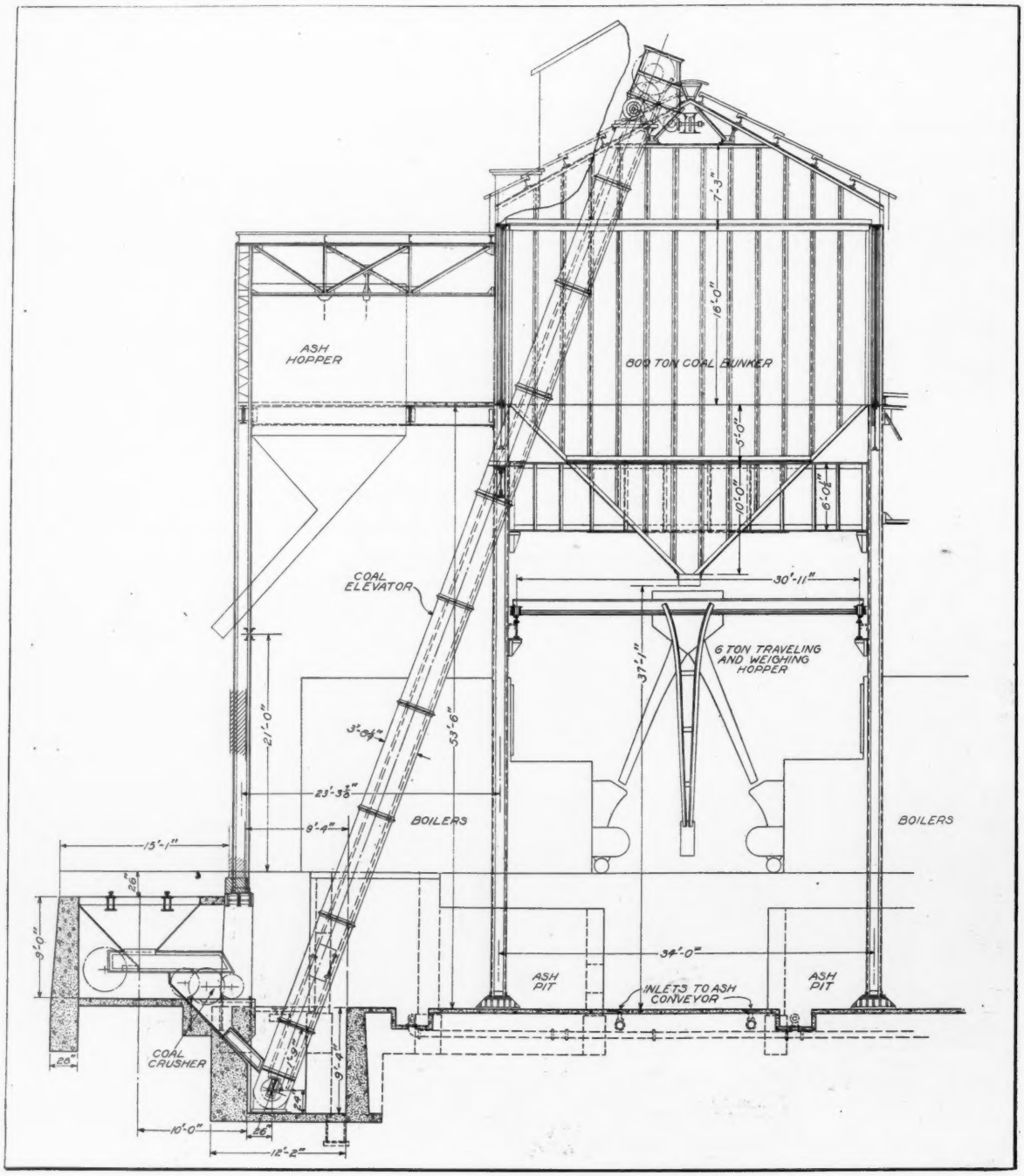


FIG. 1. ELEVATION SHOWING COAL AND ASH HANDLING SYSTEMS

hopper, which may be run either by motor or by hand, receives the coal from the bunker and delivers it to the boilers. The beam of the coal scales is at a convenient height from the floor for a man to balance his scales and the weights are automatically punched on a card.

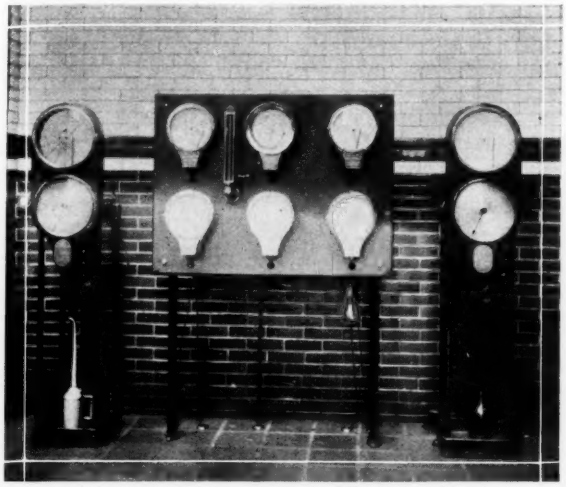


FIG. 2. RECORDING GAGES, THERMOMETERS AND METERS

A record is thus made possible of the coal fed to each boiler, but only the day and night supplies are kept for general purposes.

Ashes are conveyed to an elevated hopper of 2 carloads capacity, with a chute leading to the railway track. A Darley system of vacuum ash handling is employed. A Buffalo blower run by a 30-hp. motor furnishes the vacuum and is run 2 hr. a day, which is sufficient to elevate all the accumulation of ashes for one day's run. The conveying pipe is 8 in. in diameter and some difficulty was encountered due to the tee at the top of the riser wearing out. This difficulty has been overcome by putting in an ordinary tee, but a hole was bored in the top and a chilled steel plug put in on the run. The clinkers strike against this plug and are broken up; the plug being removable is easily replaced and prevents wear of the tee.

The floor of the boiler room extends some distance under the grate and catches the unburned coal and coke that fall through. This is scraped to the front and thrown back into the hopper of the furnace. Ashes and clinkers are discharged over the end of the grate into the ashpit which has an opening to the front in the basement. When cleaning the ashpit the door is opened and, with the cover of the ash conveyor removed, ashes are scraped over the inlet by 2 men, one using a long handled hoe, scraping from the rear of the ashpit, the other taking them from the front; by this system the conveyor is worked full capacity, where one man could keep it supplied only part of the time.

Soot is removed from the tubes by means of Vulcan soot blowers which are operated once a day.

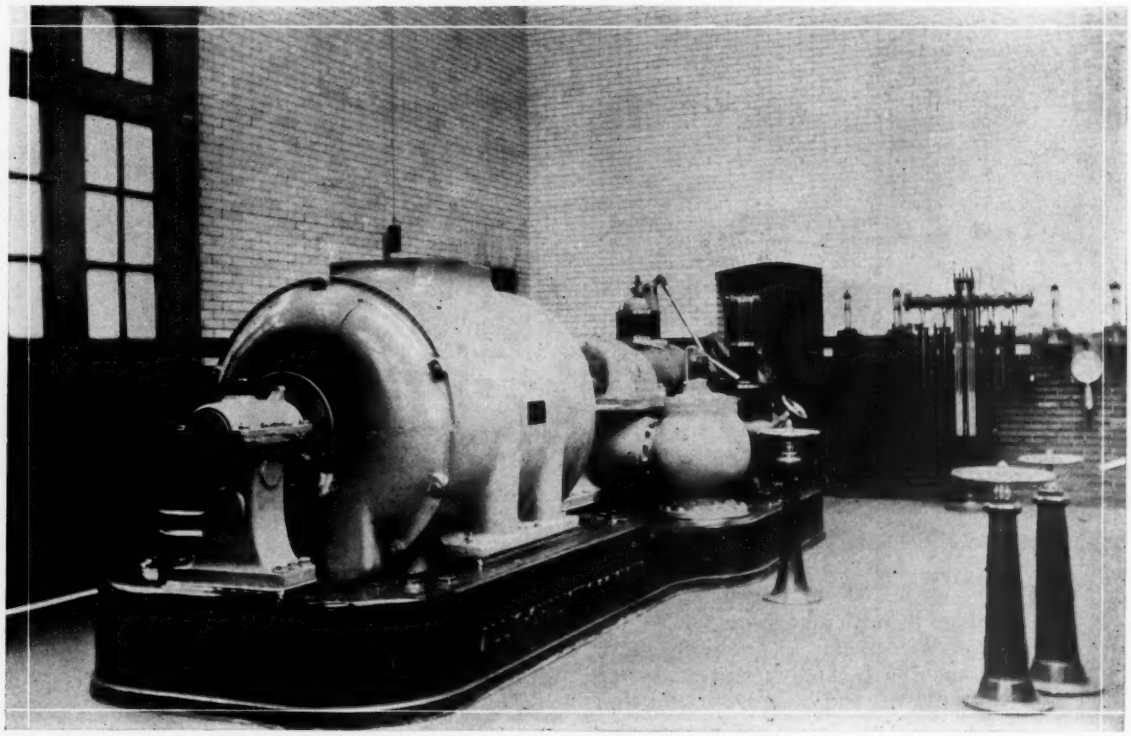


FIG. 4. RECENTLY INSTALLED GENERATING SET

Feed water is taken from the city mains, which is Lake Michigan water, and treated in a Kennicott softener of 3000 hp. capacity before being fed to the boilers as make-up water. All returns from the heating system are fed to the boilers through an open feed water heater which is provided with an automatic valve to

admit make-up water from the softener as needed. The temperature as it enters the boilers is between 170 and 180 deg. Heat is supplied by the exhaust from all auxiliary pumps and engines of the plant.

The company maintains its own chemical laboratory and the softening systems are run under directions from the chemist who requires the attendant to test 5 samples a day to guide in treating the water. This method of treatment has proved very successful and no trouble is experienced with scale. The boilers are run for 12 weeks without shutting down or change of water, except for blowing down twice a day, but after this period of operation they are given a thorough cleaning, inside and out, and besides the inspection given by the engineer in charge, the state inspector is called in to pass on the boilers before they are put back into service again.

that the coal burns clear to the water back with the result that the flue gases show 11 per cent CO_2 as an average.

Feed water is delivered to the boilers by 2 pumps each 12 by 8 by 12 in., outside center packed, through 2 feed lines running under the front of the boilers and cross valved so that tests can be made of any boiler without disturbing in any way the operation of the others. These pumps are under the control of a pump governor and the boilers are equipped with feed water regulators, also high and low water alarms.

In the feed lines are 2 5 by 1⅝-in. Venturi water meters which indicate and record the flow of water to the boilers. One of these meters, however, is being converted into a steam flow meter to be used to show the amount of steam delivered for heating purposes. This

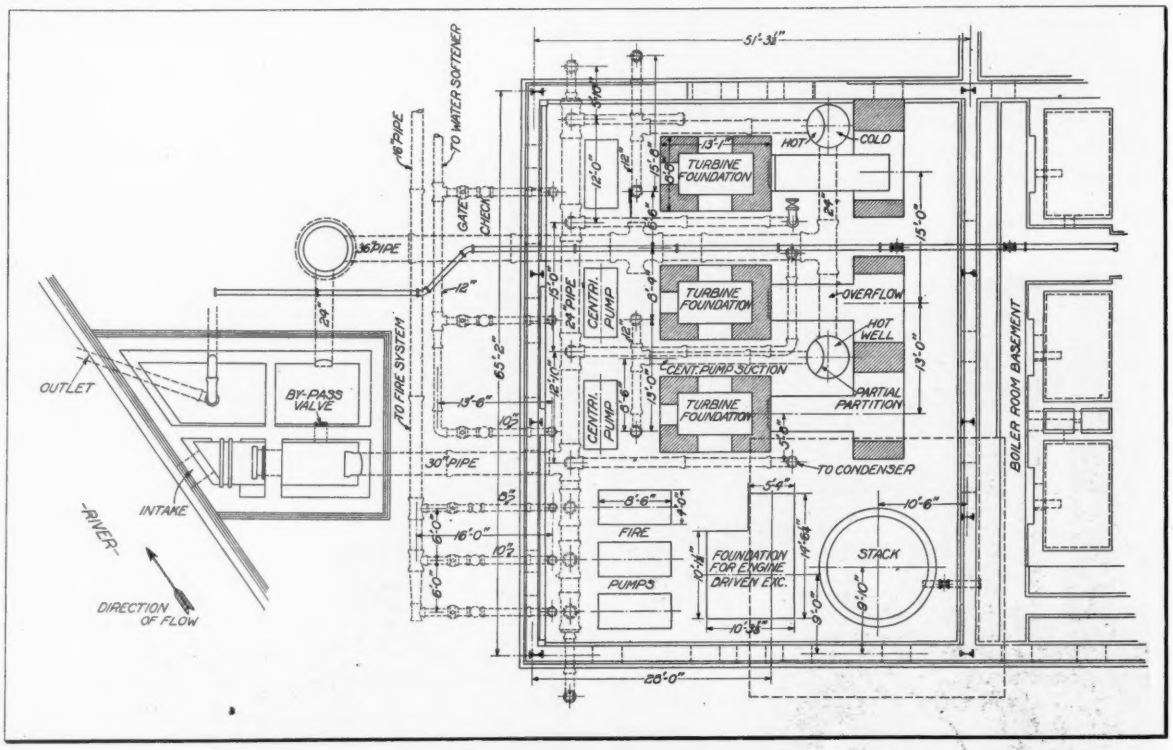


FIG. 5. PIPING TO CONDENSERS

In the operation of the boilers the load is quite steady and varies from 500 to 700 hp. per boiler although occasionally it runs up to 1000 hp.; the aim, however, is to run a little above the rating of 585 hp.

The stack is a Wiederholdt tile-concrete, 12 ft. internal diameter and 185 ft. high, giving an average draft on the boilers of 1 in., and over the fire the draft is about 0.3 in. Under these conditions the thickness of the fuel bed of 5 in., gives best results, the evaporation averaging 9 lb. of water from and at 212 deg. per pound of coal. The rate of combustion of the fuel averages 18 lb. coal per square foot of grate surface per hour, although at times it runs up to 30 lb. Draft is controlled by a hand operated damper in each boiler breaching, and the temperature of the flue gases averages 475 deg. The speed of the grate is so regulated

will enable the engineer to make proper charges for steam to the generators and to the heating systems. Live steam at 100 lb. pressure and considerable superheat is transmitted to the various buildings where it is reduced in pressure to the requirements of the service which it performs.

The main steam header is a vertical rectangle placed back of the boilers, the upper side of which takes steam from the boilers through long radius bends, each lead being provided with a stop valve and a non-return valve. The lower side of the header is below the boiler room floor and is drained by a receiver separator at each end. From the upper side of the pipe steam is taken to the turbines through separators and vertical risers, which arrangement keeps the turbine room piping all beneath the floor.

Turbines and Condensers

The generating equipment consists of 3 Allis-Chalmers turbo generators; 2 of these are rated at 1500 kv.a. and generate current at 440 volts, 60 cycles and 3 phase, running at 1800 r.p.m. The third unit, which was the last to be installed, has a capacity of 600 kv.a. at the same voltage. As originally installed and operated, the large turbines had a bleeder connection to the heating systems from the intermediate stage, but this has been abandoned, as it was found more economical and less complicated to furnish steam at high pressure direct from the boilers.

The condenser for each turbine is located beneath the turbine, between the piers of the foundation, taking the steam direct from the turbine without the necessity of piping. Tomlinson Type C condensers are used and with 60 deg. water maintain a vacuum within 1.5 in. of the barometric reading. The pumping equipment consists of 2 single-stage centrifugal pumps mounted on the same shaft with an 85-hp. induction motor. One of these pumps takes water from the condenser head and discharges to the hot well against atmospheric pressure while the other takes water from the intake and discharges it through an air ejector nozzle which is connected to the condenser head and serves as an ordinary dry vacuum pump.

River water is used for condensing purposes and being very dirty, the selection of the proper type of condenser was an important item. The head of this condenser is pear shaped, enclosing the spray nozzle through which the condensing water enters. The passages are large and offer no restriction to the water; to protect the condenser from trash, however, a twin strainer is placed in the inlet to each condenser.

By a novel system of piping, part of the condensing water may be used again and thus keep the discharge water as hot as is practicable so that it may be used to best advantage in the softening system. The hot well has a partition extending nearly to the bottom; the condensing water and water of condensation is discharged to one side of the partition and is hotter than that from the ejector so that the centrifugal pumps which deliver to the main water softener have their suction pipes connected to the hot side of the hot well. What water is not pumped to the softener flows to an underground tank, thence to the river, or to the inlet side of the condenser again by means of a bypass valve, which is regulated to give proper temperature. During winter time considerable of this water can be used over again and still maintain a good vacuum.

The main water softener furnishes treated water for the factory process and has a capacity of 150,000 gal. an hour. It is supplied from the hot well as stated above by 2 De Laval centrifugal pumps, one driven by a turbine, the other by motor.

Excitation for the generators is furnished by either of 2 units; one is a 75-kw. Allis-Chalmers d.c. generator connected to an Ideal engine, and the other is a 150-kw. De Laval turbo unit which can also carry the lighting load of the plant.

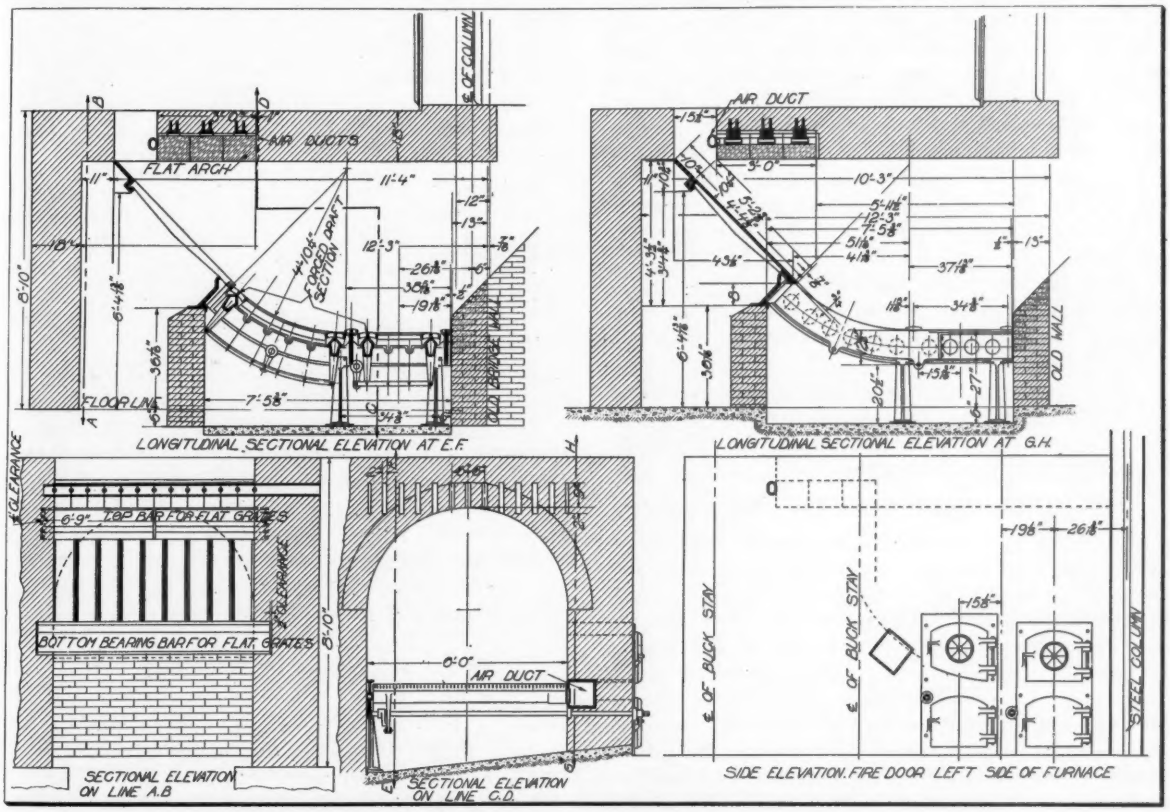


FIG. 6. ELEVATIONS OF COMBINATION TAN BARK AND COAL FURNACE

The switchboard is built for 480 v. and has mounted upon it remote control oil switches with time limit relays, Thompson polyphase recording wattmeters, a Tirrill regulator and synchronizing indicator besides the necessary ammeters, voltmeter and service switches. All motors are for 440 volts, 3 phase, while the lighting system is furnished with current at 110 volts through 3 75-kw. transformers located in the basement below the switchboard.

That this plant has been a profitable investment is evident from the fact that the cost of coal, labor, oils and supplies is $40,000 a year less than it was when the old plant was in operation. The cost of current at the switchboard, which includes coal, labor and oil, is $0.0038 per kw.-hr.

Much credit is given to the system of records for the high economy obtained in this plant, as the instruments provided not only guide the men in the plant in their work, but give the management a check upon the results obtained. Each day, from the records obtained, a report is made out showing: coal consumed—total, day and night; boiler horsepower-hours developed—total, day and night; pounds coal per boiler horsepower-hour—day and night; water evaporated per pound coal from and at 212 deg.—day and night; kilowatt-hours generated—total, day and night; average kilowatts per hour—day and night.

When the steam meter is installed upon the heating system its readings will be made part of the records and the steam consumption of the generators per kw.-hr. can then be added to the report.

At present the plant is operating only day times, and the force consists of an engineer, a fireman and an ash man. At night only a fireman is required to keep the boilers in service for heating.

Test of Combined Tan Bark and Coal Furnace

This company operates a number of tanneries in different parts of the country and has experienced some difficulty in burning spent tan bark which accumulates as a refuse. To use this efficiently as a fuel, Mr. Bossert designed a furnace, which is now in operation at Cheboygan, Mich., drawings of which are shown in Fig. 6. It is a combination furnace which burns both tan bark and coal. Spent tan bark is fed through an opening in the front of the dutch oven furnace and falls by gravity over a stationary slanting grate, which serves as a drying plate, to a curved shaking grate where combustion is completed. Forced draft is used in this part of the furnace, being supplied through tuyeres in the grate. Over the front of the grate is a flat arch provided with an air space through which air is forced to the upper part of the furnace, being heated during its passage through the arch.

Near the bridge wall is a section of the grate upon which coal is fed by hand through a door at the side of the furnace.

Results obtained from this furnace are exceptionally good considering the fuel, as will be seen from the following report of a test made recently.

This test was made to arrive at the capacity and economy of an inclined grate and a horizontal grate, a combination furnace to burn spent tan bark and coal, separate grates.

Duration of test	10 hr.
Kind of boilers	Tubular
Kind of furnace	Combination bark and coal
Dimensions	
Grate surface, coal grate	14.55 sq. ft.
Grate surface, bark grate	51 sq. ft.
Heating surface	1460 sq. ft.
Diameter and length of boiler	72 in. by 18 ft.
Number and size of tubes	64 4-in. flues
Ratio of grate to heating surface	1 to 22.27
Pressures	
Pressure by gage	97.0 lb.
Draft in uptake	0.75 in.
Temperatures	
Feed water temperature	187.25 deg.
Escaping gases	672.00 deg.—?
Fuel	
Kind of coal	Penn. mine run
Moisture in coal	1.66 per cent
Ash	8.44 per cent
B.t.u. oven dried	14,073
Spent Tan Bark	
Moisture in tan bark	75.5 per cent
Ash in tank bark	0.86 per cent
B.t.u. oven dried	11,731
Total coal consumed	3350 lb.
Total dry coal consumed	3491 lb.
Total spent tan bark consumed	24,800 lb.
Total dry spent bark consumed	6076 lb.
Fuel Per Hour	
Coal per hour	355 lb.
Dry coal per hour	349 lb.
Spent tan bark per hour	2480 lb.
Dry bark consumed per hour	607.6 lb.
Coal consumed per sq. ft. of grate surface, per hr.	24.4 lb.
Dry coal consumed per sq. ft. of grate surface, per hr.	24.00 lb.
Bark consumed per sq. ft. of grate surface per hr.	48.62 lb.
Dry bark consumed per sq. ft. of grate surface per hr.	11.91 lb.
Total Water	
Total weight of water fed to boiler	67,600 lb.
Factor of evaporation	1.064
Equivalent water evaporated from and at 212 deg.	71,926.4 lb.

Evaporation of Water by Coal at 72 Per Cent Efficiency

B.t.u. per lb. of dry coal from analysis	14,073
72 per cent of 14,073 B.t.u.	10,132.56
Evaporation of water from and at 212 deg. F. per lb. of dry coal	10.44
Lb. of water evaporated from and at 212 deg. F. by dry coal	33,446 lb.
Lb. of water evaporated from and at 212 deg. F. by dry bark	35,480 lb.
Lb. of water fed to boiler and evaporated by bark	33,346 lb.
B.t.u. per lb. of tan bark, dry	11,731
B.t.u. per lb. of wet tan bark	2874

B.T.U. Loss Due to Moisture in Tan Bark

$75.5 \div 100 \times [(212 - 80) + 970 + .48\ (550 - 212)] = 979.$

Total heat value of 1 lb. of spent tan bark....1895

Evaporation Per Lb. of Spent Tan Bark

Water evaporated per lb. of bark.....1.344
Equivalent evaporated from and at 212 deg. F. per lb. of bark as fired.....1.43
Equivalent evaporated from and at 212 deg. F. per lb. of dry bark as fired.....5.84
Efficiency of boiler including grate based on dry spent tan bark .....73.27 per cent
$1.43 \times 970 = 1387.1$ $1387.1 + 1859 = 73.27.$
Combined efficiency of bark and coal furnace, ...72.6 per cent

Horsepower

Horsepower developed by bark and coal.....208.48
Builder's rated hp.....146
Percentage of builder's rated hp. developed...142.8
Horsepower developed by coal fired.....105.64
Horsepower developed by bark fired.....102.84

The results of the test made show a very good efficiency of boiler and grate and under ordinary running conditions, the same results should be obtained, as bark is fed to the grate automatically in equal quantities, the choking of fire is thus overcome, the firemen cannot feed fuel any faster than the fuel is consumed on the grates.

The moisture in bark by analysis showed 75.5 per cent and the B.t.u.'s lost due to heating bark to 212 deg. F., plus heat to change water to steam and heating this steam to the temperature of flue gases of 550 deg. F. was deducted. This heat loss is equal to 979 B.t.u. for every pound spent tan bark burned. The average pyrometer temperature of flue gases shows 672 deg. F. but it was found afterwards that the pyrometer was out of order and 550 deg. F. was assumed, this being the average temperature of flue gases taken from other tests made under like conditions.

Wood chips can be used in this furnace, but to feed properly, all large pieces and sticks must not be accepted from saw mills, as sticks and large pieces of wood interfere with automatic gravity feed of fuel.

Sprinkler Systems

Types; Operation; Spacing of Heads; Piping; Alarms. By L. M. Lewis

WHEN WE REALIZE that the total fire loss per capita in the United States is $2.25 a year, or nearly 5 times greater than that of any European country, and that the toll of human lives annually ranges from 1000 to 1500, we are forced to feel the pressing need of the employment of adequate fire prevention and fire protection methods and appliances. And to add to the force of these statements, we find from the reports of fire-insurance experts that 90 per cent of the fire loss in this country is preventable and may therefore be justly said to be due to criminal negligence.

Many states are already realizing that something can and must be done to place the responsibility for this waste of life and property on the individual and indifferent and negligent property owner and tenant and many efforts are being made to secure the adoption of every possible means to insure the safety of property and human life. Among the recommendations made by the authorities in charge of the enforcement of these acts is the universal use of automatic sprinkler systems.

Wet Systems

Two general types of sprinkler systems, the so-called "dry" and "wet" systems, are in use. In the former, the piping is filled with air under pressure and is employed only in such places as are subjected to freezing conditions, while in the wet system which can be used wherever freezing conditions do not exist and which has been proved the simpler and more reliable of the 2, the pipes are constantly filled with water, also under pressure.

The general design of the piping of this system depends wholly upon the construction of the building being protected, but may briefly be said to consist of horizontal pipes connected by means of cross mains to a central vertical main or riser, which in turn connects directly to the source of water supply, thus keeping the system under a constant pressure.

All horizontal pipes are carried on suitable hangers near the ceilings of the buildings and terminate in outlets provided with sprinkler heads located according to the construction of the building and the nature of the hazard.

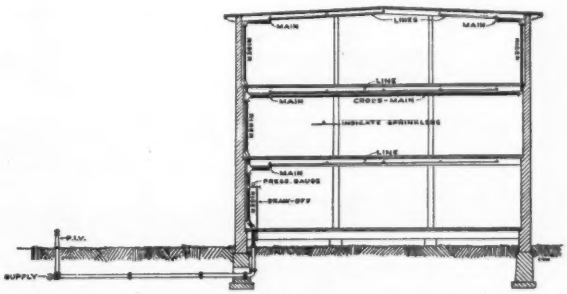


FIG. 1. ELEVATION OF AUTOMATIC SPRINKLER SYSTEM

Sprinkler Heads

These are automatic valves the disks of which are held upon their seats by some form of fusible link of such a composition that when the surrounding temperature exceeds a predetermined value the link will melt, release the valve disk and allow the water to strike some form of distributer from which it is deflected both downward and upward in a heavy rain effect.

A typical form of sprinkler head is shown in Fig. 2. Two intermediate pieces or links held in place by a third fusible link keep the disk on its seat. Melting of

the fusible link releases the other 2, which allows the pressure of the water to throw out the valve disk and release the water, thereby quenching any fire within its range.

FIG. 2. TYPICAL SPRINKLER HEAD

Spacing of Sprinklers

Spacing and location of automatic sprinklers is governed by the construction of the ceiling or roof under which they are placed and the nature of the hazard entailed. Typical modern methods of locating and spacing sprinklers in the various forms of building construction are shown in Fig. 3 and table in Fig. 4.

Special hazard mentioned in the above table refers to unusual conditions similar to those encountered in

FIG. 4. TABLE OF SPRINKLER SPACINGS WITH VARIOUS TYPES OF BUILDING CONSTRUCTION AND NATURE OF HAZARDS

	One row of sprinklers placed midway between beams in each bay.	Over 20 lb. pressure at highest sprinklers		Less than 20 lb. or supplied primarily by tank.	
		Medium Hazard	Special Hazard	Medium Hazard	Special Hazard
Standard Mill or Slow-Burning Construction (Timbers over 5 ft. apart)	12 ft. Bays 11 " " 10 " " 9 " " 8 " " 7 " " 6 " "	8ft.apart 9 " " 10 " " 11 " " 12 " " 12 " " 12 " "	7ft.apart 8 " " 9 " " 10 " " 11 " " 11 " " 11 " "	7ft.apart 8 " " 9 " " 10 " " 11 " " 11 " " 11 " "	6ft.apart 7 " " 8 " " 9 " " 10 " " 10 " " 10 " "
Open Joisted Ceilings - Timbers less than 5 ft. apart	Place sprinklers at right angles to joists.	8 " "	7-1/2" "	7-1/2" "	6-1/2" "
	Parallel to joists.	10 " "	9ft. "	9ft. "	8ft. "
Smooth sheathed or plastered construction	12 ft. Bays 11 " " 6 to 10ft."	8ft.apart 9 " " 10 " "	7ft.apart 8 " " 9 " "	7ft.apart 8 " " 9 " "	6ft.apart 7 " " 9 " "
	Bays 12 to 25 ft. 2 lines of sprinklers Bays 25 ft. or over, lines not over 10 ft. apart.				
Semi-mill or Panel Construction. Timbers 3ft. to 5ft.apart.	Place sprinklers either in alternate bays or under alternate beams or alternately in centre of bay and under beam sprinklers should be staggered on adjacent lines.				
Concrete Construction	Apply rules for slow-burning construction (medium hazard) where practicable. Distance centre to centre of sprinklers never to exceed 12 ft.				
Pitched Roofs	Where roof pitches more than 1 ft. in 3 ft., place one line of sprinklers in peak or 2 lines not more than 2-1/2 ft. from peak on either side. In saw-tooth roofs, end sprinkler not over 2-1/2 ft. from peak of saw tooth.				

Notes

Not more than 100 sq. ft. of ceiling area to be allotted to any one sprinkler. Distance from walls to centre of sprinklers not to exceed more than 1/2 the distance between centre to centre of sprinklers in the same direction. A line of sprinklers to be run on each side of partitions. Sprinklers must be placed in all small bays or pockets, formed by bay timbers or beams. Sprinklers should be placed vertically and be parallel to roof or ceiling.

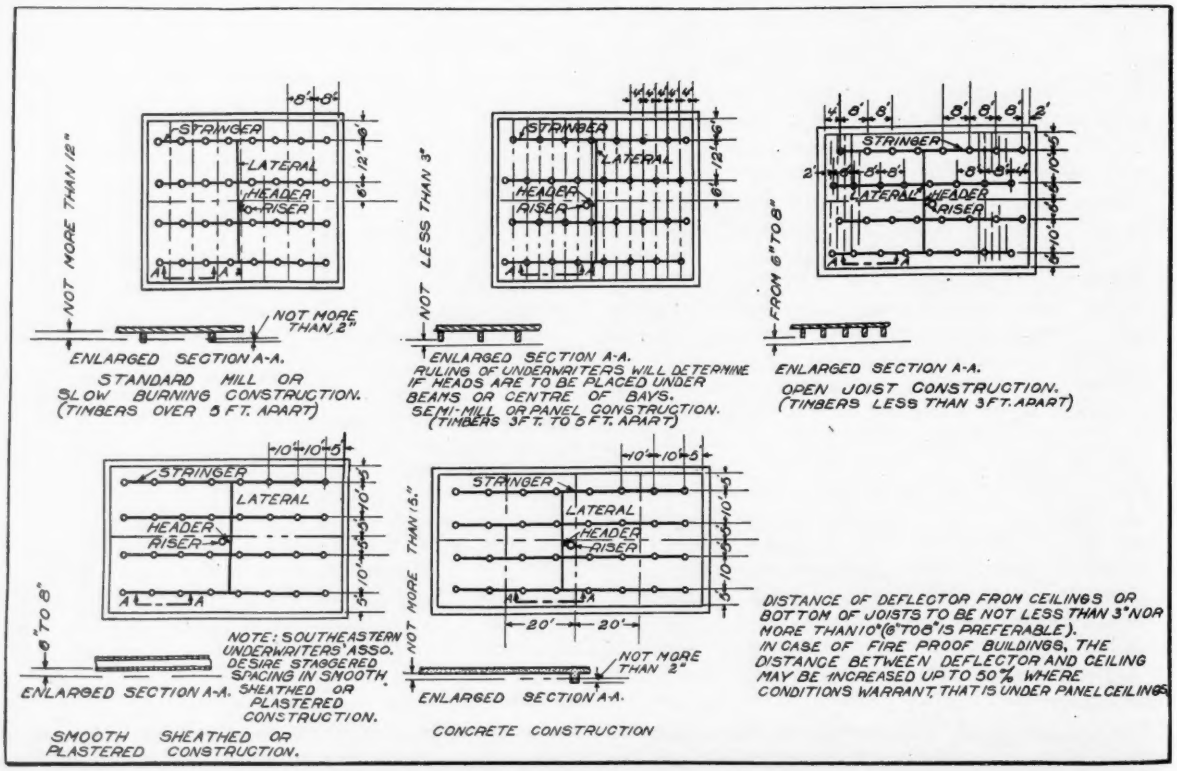

STRINGER
LATERAL
HEADER
RISER
NOT MORE THAN 12"
NOT MORE THAN 2"
ENLARGED SECTION A-A.
STANDARD MILL OR SLOW BURNING CONSTRUCTION. (TIMBERS OVER 5 FT. APART)
NOT LESS THAN 3"
ENLARGED SECTION A-A.
RULING OF UNDERWRITERS WILL DETERMINE IF HEADS ARE TO BE PLACED UNDER BEAMS OR CENTRE OF BAYS.
SEMI-MILL OR PANEL CONSTRUCTION. (TIMBERS 3FT. TO 5FT. APART)
FROM 6" TO 8"
ENLARGED SECTION A-A.
OPEN JOIST CONSTRUCTION. (TIMBERS LESS THAN 3FT. APART)
6" TO 8"
NOTE: SOUTHEASTERN UNDERWRITERS' ASSO. DESIRE STAGGERED SPACING IN SMOOTH SHEATHED OR PLASTERED CONSTRUCTION.
ENLARGED SECTION A-A.
SMOOTH SHEATHED OR PLASTERED CONSTRUCTION.
NOT MORE THAN 15"
20'
NOT MORE THAN 2"
ENLARGED SECTION A-A.
CONCRETE CONSTRUCTION
DISTANCE OF DEFLECTOR FROM CEILINGS OR BOTTOM OF JOISTS TO BE NOT LESS THAN 3" NOR MORE THAN 10" (6" TO 8" IS PREFERABLE).
IN CASE OF FIRE PROOF BUILDINGS, THE DISTANCE BETWEEN DEFLECTOR AND CEILING MAY BE INCREASED UP TO 50% WHERE CONDITIONS WARRANT, THAT IS UNDER PANEL CEILINGS.

FIG. 3. SPACING AND LOCATION OF SPRINKLERS WITH VARIOUS TYPES OF BUILDING CONSTRUCTION

painting and varnishing rooms, planing or sawing departments of wood-working establishments or picker rooms in cotton mills.

Pipe Sizes

After the sprinklers have been located according to the building requirements, care must be exercised in laying out the piping to secure the most effective distribution of water. This may be accomplished by providing central feed lines and short branches wherever possible, reduction and elimination of friction losses, provision for proper drainage, use of long-turn fittings and bends and the prevention of sagging of the lines due to insufficient or improperly spaced hangers.

In determining the size of feed mains and risers, each floor or fire section of a building is considered as one unit. Any number of floors or fire sections may be placed on the same riser and that floor or fire section having the largest number of sprinklers determines the required size of feed main or riser. Where, however, the number of sprinklers on any floor or fire section exceeds 200, additional risers should be provided, and unless absolutely necessary, no more than 8 sprinklers should be placed on any branch line.

In the table of pipe sizes are given the number of sprinklers capable of being cared for by various sized pipes:

Pipe Sizes for Sprinkler System

Size of Pipe, In.	No. of Sprinklers.
¾	1
1	2
1¼	3
1½	5
2	10
2½	20
3	36
3½	55
4	80
5	140
6	200

All distributing piping should pitch back to the riser not less than ¼ in. in 10 ft. with the riser as near the center of the distributing system as possible.

Hangers

For horizontal piping, hangers of approved size and type must be used and spaced from 8 to 10 ft. wherever practicable. On all ¾-in. lines 6 ft. or more in length 2 hangers must be used and no hanger should be placed nearer than 12 in. to the sprinkler head so as not to interfere with the proper distribution of the water. Herewith is given a table showing the sizes of rods and holding screws required for the various sizes of pipe, while Fig. 5 shows a number of approved types of hangers and methods of securing them.

Hangers for Horizontal Sprinkler Pipes

Size of Pipe	Size of Rod	Size of Rod if Threaded	Size of Drive Screws	Size of Coach Screws
Inches	Inches	Inches	Inches	Inches
¾ to 2	⅜	⅜		
2½	⅜	⅜		⅜ by 2¼
3	⅜	⅜		⅜ by 2¼
3½	½	½	No. 16 by 2	½ by 2½
4	½	½		½ by 2½
5	½	½		½ by 3
6	½	½		½ by 3
7	⅝	⅝		⅝ by 3
8	⅝	⅝		⅝ by 3

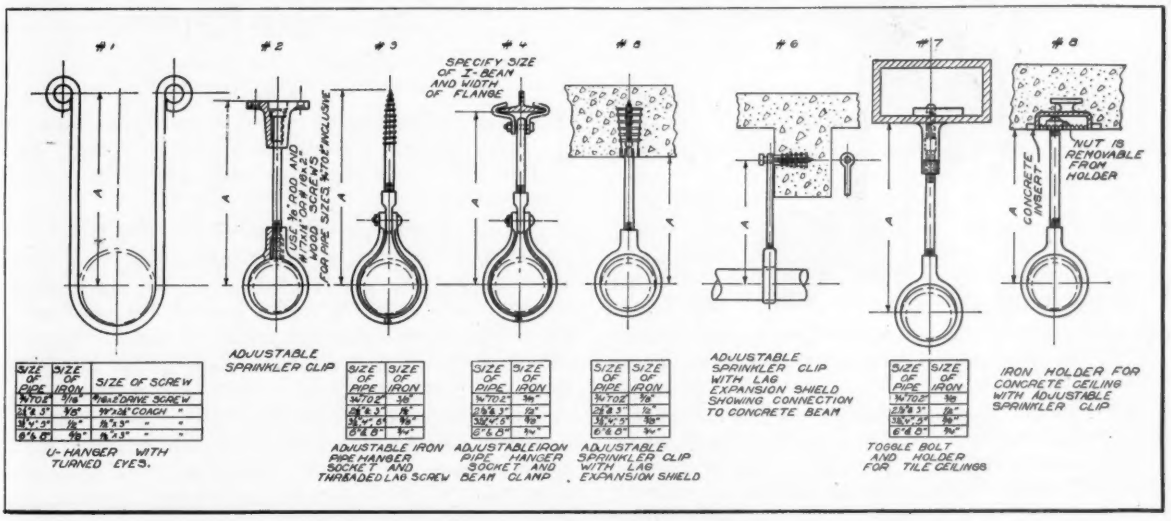

#1
#2
#3
#4
#5
#6
#7
#8
SPECIFY SIZE OF I-BEAM AND WIDTH OF FLANGE
USE ⅜" ROD AND 1¾" OG #10-2" WOOD SCREWS FOR PIPE SIZES ¾"TO 8" INCLUSIVE
NUT IS REMOVABLE FROM HOLDER
CONCRETE INSERT
U-HANGER WITH TURNED EYES.
ADJUSTABLE SPRINKLER CLIP
ADJUSTABLE IRON PIPE HANGER SOCKET AND THREADED LAG SCREW
ADJUSTABLE IRON PIPE HANGER SOCKET AND BEAM CLAMP
ADJUSTABLE SPRINKLER CLIP WITH LAG EXPANSION SHIELD
ADJUSTABLE SPRINKLER CLIP WITH LAG EXPANSION SHIELD SHOWING CONNECTION TO CONCRETE BEAM
TOGGLE BOLT AND HOLDER FOR TILE CEILINGS
IRON HOLDER FOR CONCRETE CEILING WITH ADJUSTABLE SPRINKLER CLIP

FIG. 5. TYPES OF APPROVED HANGERS AND METHODS OF SUPPORT

Drain Lines

In order that the individual floors or sections may be cut out for repairs or alterations and at the same time retain the remainder of the system in an operative condition it is necessary that individual valves to control the various floors and sections be installed, and provided with a drain placed on the system side of each such valve. In addition, a 2-in. drain line must be placed at the base of every riser on the system side of the main controlling gate valve. Where a large number of floors are equipped with control valves a drain riser should be used with the individual drains connected thereto.

Wherever an alarm valve is installed at the base of a riser and in close proximity to the main controlling

gate valve, the drain from the system side of the alarm valve may be considered as sufficient drainage. These alarm valves must, however, have a 2-in. drain outlet cast integral with the valve body.

Wherever the piping is pocketed on account of building conditions, a drain must be provided at the pocket either by placing a plug in a fitting or by placing a valve at this point. Where a valve is used, the outlet side should be provided with a plug unless connected to the regular drain system.

Test Lines

Sprinkler systems may go from year to year without ever being called into service and as a consequence, the man in charge of such a system is at a loss to know whether or not, in the event of a fire, the system will be in operating condition. Test lines at least ¾ in. in

FIG. 6. ALARM CHECK VALVE, SHOWING MECHANICAL AND ELECTRICAL ALARMS ATTACHED

diameter should therefore be installed and connected to the top of the various risers and made to discharge into a drain or run through walls and caused to discharge on the roof of the building. Each such test outlet should be provided with a valve and a sight glass for facility in controlling and determining the passage of water.

Valves

Controlling gate valves and check valves must be placed on each separate water supply line and on each riser, and must be so placed that by closing the gate valve on the system, access may be had to the interior of the check valve for cleaning or repairs without draining the system of water.

All valves must be of a type and make known as the Underwriters' Approved Pattern and when 2½ in. and over in size, must have flanged ends, while those 2 in. and under may have screwed ends. All controlling gate valves must be provided with approved means of fastening or locking in an open position.

Automatic Alarms

To provide against the opening of a sprinkler head without the knowledge of the man in charge of such a system, automatic means of indicating such an opening must be provided. This is accomplished most satisfactorily by installing in each riser an alarm check valve so arranged that the passage of water through it, due to the opening of a sprinkler, opens an auxiliary valve and allows water to pass through a mechanical water wheel or motor to which is attached a steel gong placed on an exterior wall of the building or to an electric circuit closer controlling an electric bell circuit with bells placed on one or more floors of the building.

Figure 6 illustrates a typical alarm check valve showing both the mechanical and electrical alarms attached.

Concealed Piping

All concealed piping must be of wrought iron covered with 2 coats of a good protective paint, one before and one after installation, or must be placed in properly constructed ducts, or must be imbedded in a good grade of Portland cement or its equivalent.

When unconcealed, but subjected to corrosive fumes or gases, 2 coats of a good protective paint or coating must be applied to the piping only. Noncorrosive sprinklers must always be used.

Condenser Repair

Cleaning Out Cold Oil and Chasing a Leak. By L. K.

IN A pumping station where I was once employed, there was in service a condensing pumping engine that had its vacuum gage connected to the vacuum pump suction pipe.

The condenser was connected to the suction side of pump, which was of the waterworks type; that is, the steam passed through the tubes and the water on the outside. All the water passed through the condenser—about 600 lb. of water per pound of steam. The condenser contained 2 sq. ft. of cooling surface per horsepower, so that the condensed steam was cooled practically to the same temperature as the cooling water.

There was no oil extractor on the exhaust pipe to the condenser, so that all the oil used by the engine passed to the condenser and lodged in the tubes, especially in the winter when the water was close to freezing.

When the pump was running, the vacuum gage showed the regular amount of pressure, which was 27 in.

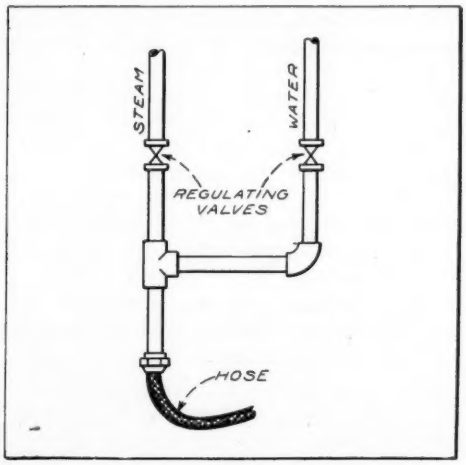
After the engine had been operated a few months in cold weather, the exhaust pipe became so hot that a person could not hold his hand on it, whereas, he could before when the condenser was all right. This showed that the vacuum gage was not indicating the correct pressure in the exhaust pipe.

One head of the condenser was taken off and a hand plate on the other end removed. A light was put inside the handhole, and, on looking through the top tubes from the other end, the light could hardly be seen. The bottom ones were completely filled up. This was the cause of the exhaust pipe's becoming hot, as the steam could not readily pass through the tubes, therefore making an increased pressure in the exhaust pipe. If the vacuum gage pipe had been connected to the exhaust pipe, as it should have been, the trouble would have been noticed before.

To remove the oil from the tubes, a hose with a nozzle was inserted in the end of the tube and water under 100 lb. pressure was turned on. This would not

clean them out very well and took considerable time. It was decided that hot water would be better, so a steam and a water pipe were run up close to the condenser head and connected up as shown in sketch. With this arrangement, we could get all the hot water needed, and at the right temperature to do the work, which took only a short time.

On another engine, the vacuum gage registered 2 in. below normal. The steam and exhaust valves and the piston rods of the low-pressure cylinders were tried with a lighted candle to see if there was any air leaking in around the packing boxes, but no leak was found. All pipe joints between low pressure and condensers were examined and tested, and every place where it was



CONNECTIONS OF STEAM AND WATER TO HOSE

thought possible for air to get in. The pump valves were looked over, but they were found to be in good shape. The vacuum gage was tested and registered correctly. All hopes of locating the trouble were about gone, when someone thought of the gage piping. The pipe was made of wrought iron and part of it, being under the engine room flooring, was hard to get at to examine. The vacuum gage was connected at the condenser, which registered the regular vacuum. This showed that the trouble was in the pipe. The pipe was taken down and found to be split for several inches. A brass pipe, which is not so liable to split, was put in place of it.

Improving Combustion

How the Analysis of CO_2 Reduced Operating Expenses. By J. O. Benefiel

At the beginning of the present year, I concluded to see what could be done in the way of improving the combustion conditions under our 4 horizontal tubular boilers and, as a preliminary step, started taking CO_2 readings with our Orsat apparatus.

Try as we may, our original readings would not average any more than 9.5 per cent of CO_2; but after about one month's hard work of hunting and stopping air leaks I was able to raise the percentage of carbon dioxide to 10.5, a gain of 1 per cent.

After having reached this stage, we came to the conclusion that perhaps our method of firing was at fault and so went out into the boiler room and took a personal hand at the furnaces, while at the same time samples of the flue gas were being taken. By comparing the different ways of firing with the corresponding resulting CO_2 obtained, we found that by throwing 10 shovels of coal toward the rear of the grate to every 4 shovels in front, a more uniform distribution of fuel resulted and to my surprise and satisfaction our CO_2 readings varied from 10 to 14 per cent with the average at 12½.

By instructing our firemen to feed their fuel in the above-mentioned manner and thereby obtain better combustion, our coal bill, within a month's time showed a neat reduction and it made me feel that my labors were not in vain.

I realize that the installation of flowmeters and draft gages on the individual boiler would be instrumental in the further reduction of operating costs; but, as many other engineers have experienced, it is exceedingly hard to bring the management of small plants to see the value of these things.

Specifications for Cement Top Floors

THE ABERTHAW CONSTRUCTION CO., Boston, specifies as follows for cement top floors. This specification is for laying hard finish on new rough concrete, either paling or slabs supported by forms.

Finish to be mixed one part of cement to 2 parts crushed trap rock or hard gravel screening, which will pass through a ½-in. sieve, and from which the fine dust has been removed. This is to be thoroughly mixed in a mixing box or by machine mixer, with an amount of water to produce a plastic but not a sloppy consistency; spread on the under-concrete before either the finish or the under concrete has had time to set, floated with a wooden float to a true level and then lightly troweled with a steel trowel as soon as possible to bring it to proper level and to smooth the top slightly. This will give a finish which is pebbly. It will not be dead smooth or slick like a sand finish.

After the finish has been troweled and has set sufficiently so that the covering will not mar the surface, it should be covered with sawdust, sand, cloths, or any other material which will hold water on it continuously. In building reinforced concrete work, difficulty will be caused by the sand and sawdust blowing about the work, filling the forms, and generally getting in the way. In working around a textile mill there is usually plenty of old bagging, and in a paper mill there is usually plenty of old felts which can be borrowed for the purpose of preventing this.

The finish should be kept soaking wet for at least a week, or better for 10 days. After 2 days it is possible to put up studs and do miscellaneous work on top of the new finish, provided it is not allowed to dry out.

F. H. Newell, Consulting Engineer with the U. S. Reclamation Service, and until recently Director of that Service, delivered a lecture on "The Engineering and Economic Results of Reclamation Work" before the faculty and students of the College of Engineering of the University of Illinois, on March 24.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

Three-Wire Direct-Current Systems

2-Wire Generators and Motor-Generator Balancer Sets; 3-Wire Generators with Stationary and Revolving Balancer Coils

THREE-WIRE, direct-current systems find their greatest field of adaptability in moderate size isolated light and power plants. These systems allow the use of direct-current generating machinery and motors, possess the advantage of having available for use 2 different voltages and require less copper in the distribution line than a 2-wire system of equal capacity.

Modern systems of this type employ voltages of 220 between the 2 outside wires and 110 between either outside and the middle or neutral line, and may be fed either by the use of a standard 220-v., 2-wire generator operating in conjunction with a motor-generator balancer, or by the employment of a 3-wire generator.

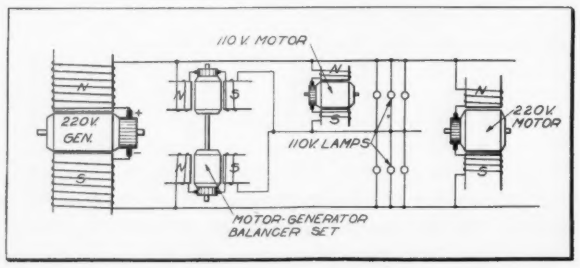


FIG. 1. 220-V. DIRECT-CURRENT GENERATOR AND MOTOR GENERATOR BALANCER SET

As the generator of the first method is not unlike any other 2-wire direct-current generator, no description will be necessary other than a brief discussion of the use of the balancer.

With any unbalancing, such as is bound to exist to a greater or less extent in all 3-wire systems, the more heavily loaded side will suffer a decrease in voltage not experienced by the opposite side carrying the lighter load.

To remedy this trouble, a motor-generator balancer set is used. This consists of 2 small direct-current machines of identical ratings, directly connected and mounted on a common base. These machines are then electrically connected in series with each other and the set connected across the 2 outside lines with the neutral wire, as shown in Fig. 1, attached to their common point of connection.

With a balanced load, the 2 machines operate as motors. As an unbalanced condition is created, however, a greater drop of voltage occurs on the more heavily loaded side, so that the armature of the machine connected to that side is acted upon by a lesser voltage, while the machine on the lighter loaded side continues to operate under the higher voltage, as a motor driving the other machine as a generator, which then, for the time being, supplies current for the excess load, thus balancing the system. By this action, it is seen that, by means of the balancer, the excess load on one side is practically thrown onto and carried by the side apparently having the lighter load.

As a rule, balancer sets have a combined capacity equal to from 4 to 10 per cent of the capacity of the generator with which they operate, and, as a method of

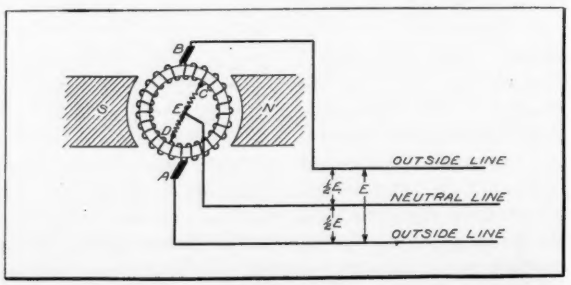


FIG. 2. ELEMENTARY CONNECTIONS OF 3-WIRE GENERATOR

protection against any excess of unbalancing which may occur, relays are provided, which, when the current through the neutral line exceeds some predetermined value, cause the main circuit breaker to be opened, thereby saving the machines from a possible burn-out.

Three-Wire Generators

LIKE THE 2-WIRE machines, these generators are provided with balancers; but instead of employing a motor-generator set, stationary coils are used, either entirely separate from the machine but connected electrically thereto, or, as in some makes, mounted directly on the revolving armature. When these balancers are not integral with the machine, it is necessary to have collector rings and brushes whereby the current is led from the armature winding to the balance coils, which are usually placed in some out-of-the-way location, such as behind the switchboard.

Connections from the armature winding to collector rings may be either single, 2-phase or 3-phase, requiring 2, 4 or 3 collector rings respectively. Of these the 2- and 4-collector ring types are in most general use.

Theory of the 3-Wire Generator

Figure 2 is an elementary diagram showing the balance coil connections with the coils mounted on the armature.

A and B represent the direct-current brushes of the generator. The balance coil is symmetrically connected to the armature winding at the points C and D, with the neutral wire connected at mid-point E.

Since connections of C and D will always be symmetrical with respect to brushes A and B, it is evident that the point E will at all times be a neutral point as between A and B, and may properly be used for the neutral connecting point. The same general argument and conclusion will apply for a multipolar machine,

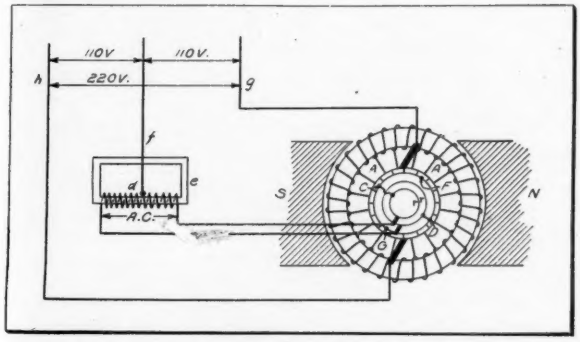


FIG. 3. 3-WIRE GENERATOR AND STATIONARY BALANCER COILS

connections being made symmetrically to as many points of the winding as there are poles, so that current from the neutral wire of the system will divide among the various sets of brushes.

With the connection as shown in Fig. 2, but 1 collector ring is necessary, while if the balance coils are independent of the machine, taps C and D connect directly as shown in Fig. 3, which illustrates the connections of a typical Dobrowolsky 3-wire generator, to 2 collector rings. Since, however, with this connection a tendency to pulsate is created, 2 additional taps are taken off at points F and G midway between C and D, resulting in the use of 4 collector rings. The arrangement of this connection, together with that of the accompanying balance coils, is shown in Fig. 4, and represents the scheme employed by the manufacturers of 3-wire generators using separate balance coils connected across each pair of 2-phase collector rings. As shown in this illustration, the middle points of the balancing coils are inter-connected, and from this connection the neutral lead of the system is brought out.

Revolving Balancer

Some manufacturers of electrical machinery build 3-wire generators having revolving balance coils, which, as shown in Fig. 5, are placed on a circular magnetic core and mounted on a cast bracket bolted directly to the back end of the armature spider, and fitting under the overhanging end windings, projecting but a short distance beyond them.

The various coils comprising this balancer are connected to the main armature winding at proper points,

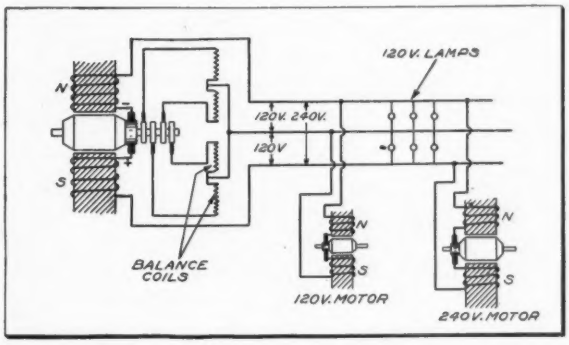


FIG. 4. 3-WIRE GENERATOR WITH 4 COLLECTOR RINGS AND STATIONARY BALANCER COILS

with the neutral connection taken through the armature spider to a single collector ring mounted in the outer end of the commutator shell.

Stationary Versus Revolving Balancers

Revolving balancers require the use of from 1 to 4 collector rings, brushes and brush holder rigging, and, in addition, require that the winding be extra heavily insulated to withstand the strain produced by centrifugal force. With the use of this integral balancer, however, necessity for the extra space occupied by the stationary coils is avoided, and the required connecting cables are eliminated.

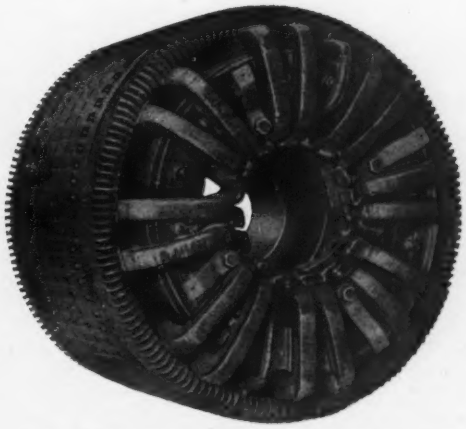


FIG. 5. ARMATURE OF 3-WIRE GENERATOR SHOWING REVOLVING BALANCER COILS

When separate balancer sets or coils are used, any direct-current generator capable of producing an electromotive force equal to that required across the 2 outside lines may be used, thus avoiding the purchase of an especially designed and built machine with its consequent higher cost.

Rotary Converters for 3-Wire Service

The development of this system has brought about the application of rotary converters for supplying 3-wire direct-current service. It is possible to operate rotary converters to supply these systems without any change of electrical connections in the standard converters, although changes in the transformer windings or connections may be necessary.

Balancing of Load

By proper arrangement of the load, the 2 sides of a 3-wire system can be almost evenly balanced. All 110-v. lamps and motors may be symmetrically connected with approximately ½ of the load between the neutral and one outside lead, and the other half between the neutral and the other outside lead. The 220-v. constant speed motors may be connected directly across the 2 outside lines, while the 220-v. variable speed motors can be connected across the outside lines for full voltage with their low-voltage connections divided between the neutral and either of the 2 outside lines. Where this arrangement is adopted, but a small proportion of the current is delivered over the neutral line, and the greater part of the total energy is transmitted at the higher voltage, resulting in a minimum line loss, saving of copper and an increased total higher efficiency of the entire system.

Flow of Energy Through Transmission Lines*

Description of a New Graphical Method of Representing the Flow of Energy. By R. A. Philip

THE flow of a material fluid, such as water or air, through the pipes which transmit it may be shown as a ribbon whose varying width represents the variations of the current.

A similar picture may be drawn of the transmission of power.

It is, however, more exact to consider that it is energy rather than power which is being transmitted because power means a flow of energy. In the distribution of energy as in the distribution of a material fluid the total quantity supplied to the distributing system, plus or minus storage in the system itself, must at every instant equal the quantity delivered, including leakage.

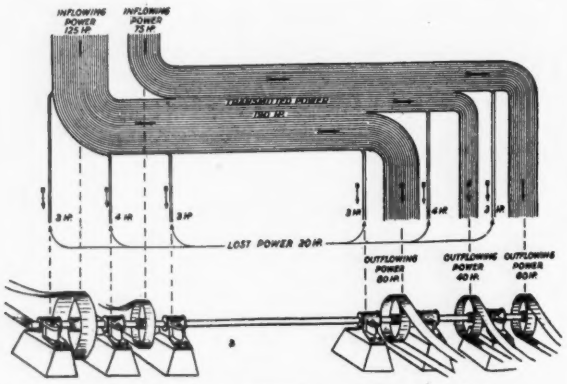


FIG. 1. FLOW OF ENERGY THROUGH A SHAFT

Figure 1 is a picture, on this basis, of the flow of energy into, through and out of a rotating shaft. Along the route of the shaft a ribbon is drawn, the width of the ribbon at each point being proportioned to the flow of energy, that is the power, at that point. Evidently, if there is no storage in the shaft the width of the ribbon can only increase at points where energy flows in and only decrease where it flows out and a change in width of the ribbon representing the main stream of energy must be exactly equal to the width of a branch at that point. At each point the flow has 2 elements, amount and direction, the former being represented by the width of the ribbon and the latter indicated by arrows marked on the ribbon.

Figure 2 shows energy transmitted thermally from a steam boiler through a steam pipe to an engine thence mechanically through a belt to a dynamo and finally electrically to a motor. The diminution of the stream of energy is indicated as due to separate thermal and mechanical losses of transformation in the engine, mechanical losses in the belt, combined mechanical and electrical losses of transformation in the dynamo and electrical losses in the wires.

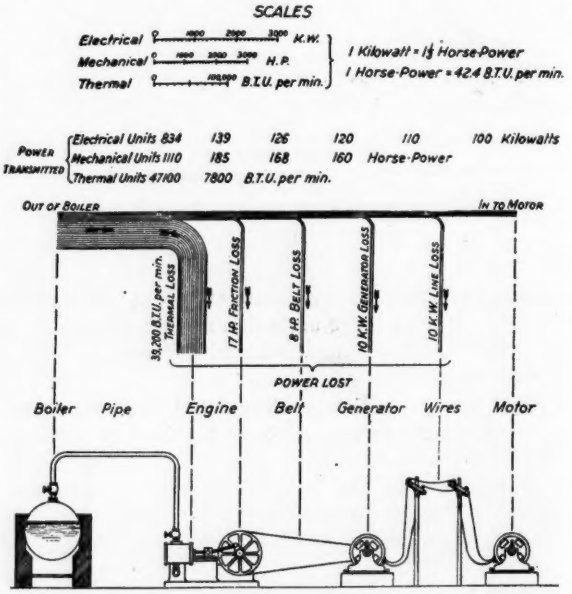


FIG. 2. THERMAL, MECHANICAL AND ELECTRICAL TRANSMISSION

The picture may be extended by tracing each branch forward or back to its furthest ascertainable end and it may be amplified by analyzing the losses into more elementary streams and by tracing the flow in greater detail; showing, say, the flow of energy through the reciprocating parts of the engine on its way from the steam pipe to the belt.

*From a paper read before a joint meeting of the A. I. E. E. and the W. S. E.

The Direct-Current Generator and Motor

In Fig. 3 the varying widths and directions of the ribbon of energy flow show the operating characteristics of generators and motors. The width of the outgoing energy stream is, of course, exactly proportional to the load, but is electrical power from a generator and mechanical power from a motor. The width of the loss stream is a maximum at full load and decreases slightly down to a minimum at no load. The input stream is exactly equal to the output stream plus the loss stream; that is, the losses are necessarily drawn from the inflow, so are supplied mechanically for a generator and electrically for a motor. The main current of energy tapers down as it passes through the machine.

The series of pictures may be considered as a moving picture film of the operation of a direct-current generator. It is first running in multiple with other sources of electric power and carrying full load. The operator turns the rheostat handle increasing the resistance of the field circuit and the outflow drops perhaps to half load; he turns the handle further and the outflow drops to zero, the reduced load on the engine being indicated by showing the engine as proportionally smaller. If the operator continues to turn in resistance the flow of electric power reverses. There is here a narrow transition stage where the losses, which are now at a minimum, are supplied both mechanically and electrically. When further resistance is turned in, the mechanical power also reverses and operation as a motor follows at no-load, fractional load, full load and overload in successive steps.

The electric machine is reversible in function. It is a generator only so long as the outflowing energy is electrical and a motor so long as it is mechanical. When it is known whether a machine is operating as a generator or as a motor 2 elements of the ribbon picture have been determined. First, which way the arrows of flow should point and second, as a consequence of this, which way the main flow tapers off.

Transmitting Medium

If energy is transmitted by a flow of water or of electricity a picture of the flow of energy will not be at all identical with a picture of the flow of the transmitting medium even though the same principles may be used in representing each kind of flow.

It will be understood that a representation of a flow of electrical energy is not at all a representation of a flow of electricity.

That the motion of energy and the motion of the transmitting medium are practically independent is also shown by the fact that shafts, belts, water and electricity may be in active motion and yet transmit no power and that the same mediums may transmit more power at times when they move slowly than when they move rapidly.

This is because the mediums transmit no power unless they move under pressure or tension. Power, whether mechanical or electrical, is considered as consisting of 2 equally important components, one of motion and one of pressure. The amount of power is the product of the 2 components. For hydraulic transmission the power in foot pounds per second is the product of the flow in cubic feet of water per second by the pressure in pounds per square foot and similarly, for electric transmission, the power in watts is the product of the current of electricity in amperes by the electrical pressure (potential) in volts.

Pictures of Accelerating Power

To make a picture of the flow of accelerating power a second ribbon may be drawn of width equal to the accelerating power, that is to the product of the mean force by the mean velocity. To distinguish between the 2 ribbons, that for energy transmission will be shaded longitudinally and that for accelerating power laterally.

Arrows have been placed on the energy flow ribbon to indicate that energy is continually passing a given

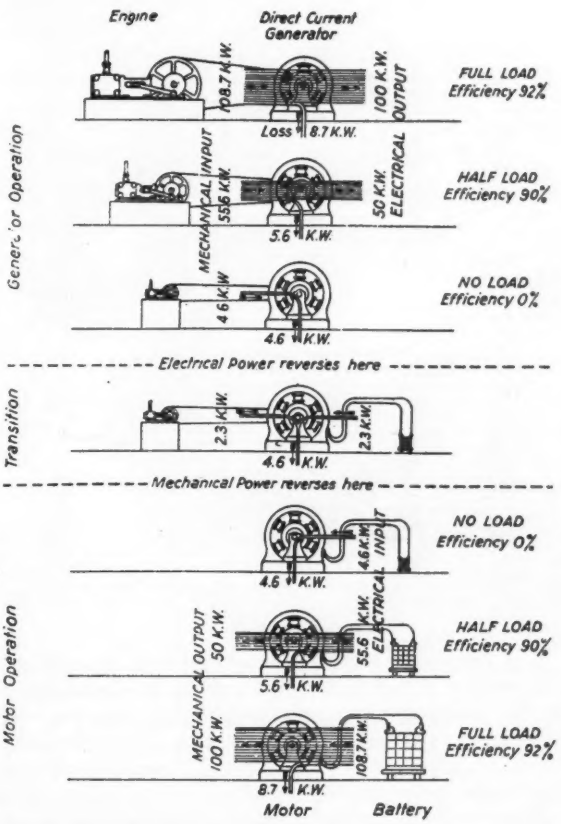


Fig. 3. Direct-current generator and motor operation at varying loads

point in one direction. With such a flow the total quantity of energy passed increases cumulatively with the time. The flow of accelerating power alternates in direction so that arrows to represent the successive instantaneous flows would point equally in both directions; however, in picturing the transmission of power by reciprocating motion we are not attempting to show the instantaneous values which fluctuate throughout the cycle but only the effect over one or more complete cycles.

While the accelerating power has no direction of flow it is associated with the transfer of energy from the rotating flywheel to the reciprocating piston which is in a determinate direction. As the de-energizing of the

flywheel and the energizing of the piston are each proportional in magnitude to the width of the stream of accelerating power it is a useful convention to mark on this ribbon arrows to indicate the direction of the transfer of energy. It is to be remembered that this transfer is a process not cumulative with time, so that accelerating power of a constant amount may flow indefinitely from a flywheel without depleting its energy supply. The arrow on this ribbon represents a transfer of energy which occurs at the time when the flow from flywheel to piston first begins and which may be described as unstable. The transfer can only be maintained as long as the flow of accelerating power continues and in an amount proportional to the flow. Any increase or decrease of flow is accompanied by a corresponding transfer of energy.

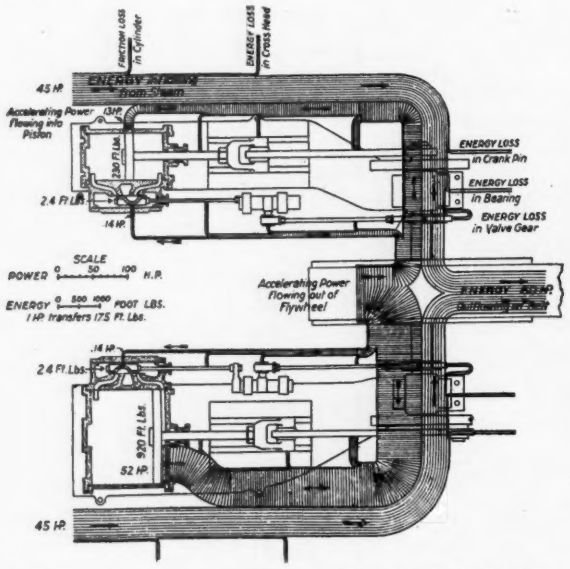


FIG. 4. FLOW OF ENERGY AND ACCELERATING POWER THROUGH ENGINE

It is further to be remembered that the direction of these arrows is determined by making the assumption that the rotating parts are the primary reservoirs of stored energy; therefore, that the flow of accelerating power (transfer of stored energy) is from the rotating parts to the reciprocating parts.

Figure 4 shows the distribution of accelerating power from a flywheel to the reciprocating parts of an engine.

The speed of the engine is 150 r.p.m. The stroke of the engine is 2 ft., giving the pistons a mean velocity of 3.1416 times $\sqrt{2}$ times 150 r.p.m. times 2 ft., or 667 ft. per min. The mean acceleration of the pistons is equal to the product of $\sqrt{2}$ times 3.1416 times 150^2 r.p.m. divided by the product of 60^2 sec. per min. times 2 ft. or 175 ft. per sec. per sec. The high pressure piston weighs 120 lb. and takes a mean accelerating force of 120 lb. times 175 ft. per sec. divided by 32.2, or 652 lb. The accelerating power is therefore 652 lb. times 667 ft. per min. divided by 33,000, or 13 hp.

The low-pressure piston weighs 4 times as much and requires 52 hp. acceleration. The valve weighs 1/6 as much and has ¼ the travel and requires 1/96 the power, or 0.14 hp.

The high-pressure piston is energized to an amount equal to ½ its weight multiplied by the square of its mean velocity or equal to the product of ½ times 120 lb. times 667^2 ft. per min. divided by 60^2 sec. divided by 32.2 or 230 ft.-lb. The low-pressure piston contains 920 ft.-lb. energy and the valve 2.4 ft.-lb. These quantities of energy are exactly proportional to the accelerating power taken by the parts, the ratio being 33,000 ft.-lb. per min. divided by the product of 4 times 3.1416 times 150 r.p.m. or 17.5; that is, a reciprocating part is energized by 17.5 ft.-lb. for every horsepower of accelerating power which flows into it.

Magnetizing Power

What has been said of mechanical motion and pressure when in quadrature applies also to electric currents and pressures.

Magnetizing power being but an electrical variety of accelerating power, its flow may be shown by a similar picture. A ribbon may be drawn for it with a width equal to the product of the mean current by the mean potential.

Magnetizing power may be measured in the same units as accelerating or other power, though in electrical work magnetizing power is measured in kilovolt-amperes instead of in kilowatts. The 2 units are of the same dimensions, a kilowatt being the same as a kilovolt-ampere except that its application is limited by an additional convention that the current and pressure are in phase. It may be pointed out that it is equally important to distinguish between kilovolt-amperes of magnetizing power where current and pressure are in quadrature and kilovolt-amperes of apparent power where no determinate phase relation is implied.

Arrows may be placed on the ribbon to show the direction in which magnetization has been displaced. The demagnetizing of the field magnets of an alternator and the magnetization of the fields of an induction motor being proportional to the magnetizing power, and due to its flow, there is a natural basis for describing the flow as being from the point where demagnetizing takes place and to the point where the magnetism reappears. This displacement of magnetization, like the transfer of energy from flywheel to piston, is a transient change which occurs when the flow begins but the displaced magnetization is only prevented from returning to its original state of equilibrium by the continuance of the flow of magnetizing power. The flow of magnetizing power is therefore not a cumulative flow, and if constant, does not further deplete the magnetization of the source from which it springs nor build up an indefinite amount of magnetization at its terminus.

Synchronous Motor and Alternating-Current Generator

An alternating-current generator can operate as an alternating-current motor and is then called a synchronous motor. The synchronous motor differs from the induction motor in being completely reversible, that is reversible as regards the flow of magnetization as well as of energy. Where an alternator transmits power to a synchronous motor there are 3 cases as shown in Fig. 5.

The simplest case is where, as in direct-current transmission, no magnetizing power is required. Each ma-

chine has its magnetization furnished locally by direct currents. The equality of excitation is indicated in the figure by drawing the exciters of the generator and motor as of the same size.

Above this case is shown the one where magnetization as well as energy is being transmitted from the generator to the motor. This indicates that the motor has insufficient magnetization; it is, therefore, said to be under-excited. The less the direct-current excitation of the motor, the greater the magnetizing power absorbed by it. This magnetizing power produces a useful magnetization in the motor just sufficient to supplement the inadequate direct-current magnetization. If the direct-current excitation decreases, the magnetizing power increases, so that finally, if the direct-current magnetization fails entirely, the magnetizing power alone may furnish approximately normal magnetization. A synchronous motor may, therefore, run without direct-current field excitation; in fact, this principle is used in starting synchronous motors and converters.

An unexcited synchronous motor is, like an induction motor, reversible in regard to flow of energy and may be used as a generator; however, an unexcited generator or motor must absorb and cannot produce magnetizing power. Therefore, an unexcited generator cannot be used to run an unexcited motor unless there is some other source of magnetizing power adequate for both generator and motor.

At the bottom of the figure is shown the case where the motor has an excessive amount of magnetization or is over-excited. The magnetizing power now flows from the motor to the generator. The effect of this flow is to demagnetize the motor, the amount of flow being just sufficient to bring the magnetization of the motor down to equality with that of the generator.

The principle is, in fact, general, that magnetizing power demagnetizes the machine from which it proceeds and magnetizes the one into which it flows. Magnetizing power may, therefore, be imagined as a current or flow of magnetization from point of surplus to those of deficient magnetization. The surplus magnetization is to be found in those machines strongly excited by direct currents, the deficient magnetization in those weakly excited and more especially in transformers, induction motors and other apparatus having no direct-current excitation at all. Strong and weak excitation are, of course, only relative terms. If the excitation of a generator and a motor are equally strong or equally weak, no flow of magnetizing power between them is necessary to preserve a balance. The voltage which a machine tends to have, due to its direct-current excitation alone, furnishes, perhaps, the simplest measure of the strength of excitation from the present point of view.

Where several alternating-current machines having direct-current excitation are connected together, the increase in the excitation of any one machine tends to raise its voltage; but this tendency is counteracted by a magnetizing current which flows away from it to the other machines, demagnetizing it and magnetizing them. A considerable increase in excitation of one machine, therefore, produces a smaller though widespread increase in magnetization of all the machines. Conversely, a decrease in excitation of one machine causes an inflow of magnetizing power and a corresponding reduction in the voltage of the whole system. This condition holds whether the machines are all alternators or all synchronous motors or a mixture of the two. The function of the machine, whether generator or motor, is immaterial, the relative excitation is the essential thing.

The relative excitation of the machines (generators and motors) on a system governs the flow of magnetization and of that alone. The origin of the excitation is immaterial as regards the flow of energy; the excitation may all come from one machine, any one, or from all the machines in any proportion. As long as some source of adequate magnetization is provided, the several machines may be driven as generators or operated as motors at will.

Consequently increasing the excitation of one of two alternators will not shift load to the other and an alternator may continue to carry its full load even if its excitation is lost.

Raising the voltage at one power house will not shift load to another and the voltage may be higher at the delivery end than at the generating end of a transmission line.

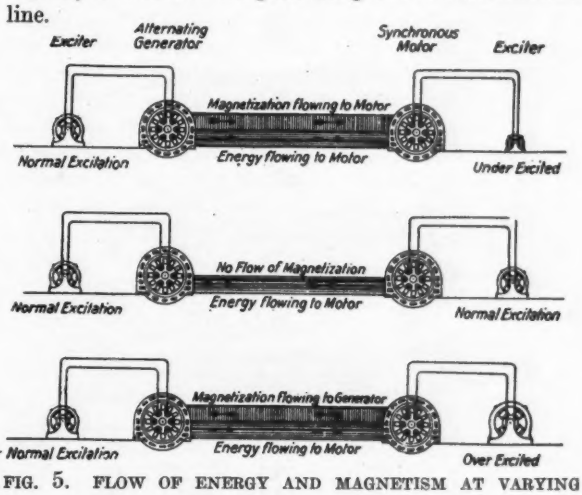


FIG. 5. FLOW OF ENERGY AND MAGNETISM AT VARYING EXCITATIONS

It is true that such increasing of excitation and raising of voltage does shift the flow of power, but it is the flow of magnetizing power only, not the flow of energy.

In every alternating-current system 2 kinds of power coexist and flow independently. The 2 kinds may flow in the same or in opposite directions. Either flow may vary without interfering with the other.

We may picture the variations in the 2 ribbons of power from a generator. The operator can with his right hand increase, decrease, stop or reverse the flow of the ribbon of energy by opening and closing the engine throttle or governor controller while with the left hand he may similarly and independently control the ribbon of magnetization by raising or lowering the excitation by the field rheostat. The governor controller and the rheostat are the 2 handles by which to take hold of the 2 flows.

TRANSFORMERS

TRANSFORMERS are used for increasing electrical pressures with corresponding decrease in current. A transformer is therefore a kind of electrical gearing through which power will pass with no change except a slight diminution to cover internal losses.

Accelerating power can be geared up or down mechanically just as well as energy flow. Similarly magnetizing power can be transformed as readily as energy flow. A transformer is therefore no barrier to the free and independent flow of the 2 kinds of power.

Transformers are a type of gearing corresponding mechanically to a direct-acting pump; the change of pressure being produced by alternating or reciprocating motion. The transformer, therefore, must itself receive a small amount of magnetizing power in order to work at all, but this is an approximately fixed amount and does not otherwise affect the free flow of magnetizing power through it.

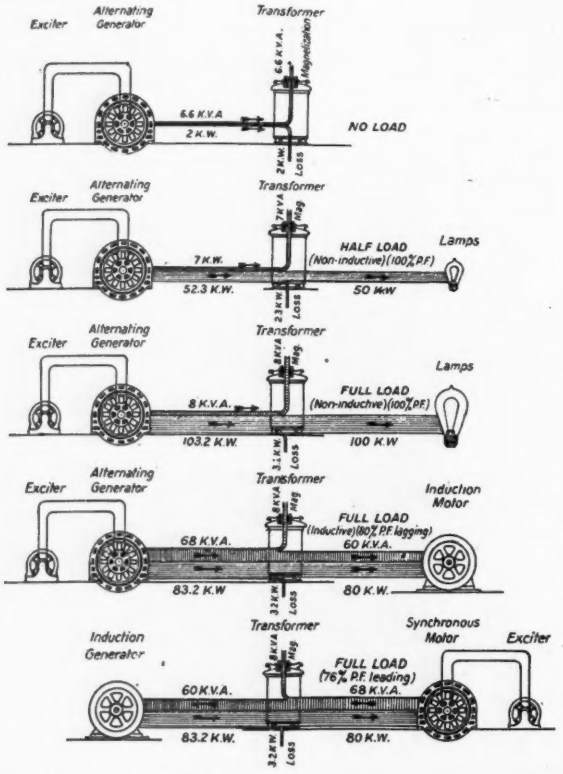


FIG. 6. FLOW OF ENERGY AND MAGNETIZATION THROUGH A TRANSFORMER

The magnetizing power taken by a transformer is similar in characteristics to that of an induction motor, the principal difference being that the magnetic design of a transformer is much more perfect than that of an induction motor so that the proportion of magnetizing power taken is much smaller.

Figure 6 shows the flow of power through a transformer. The transformer diverts from the energy stream a small branch which is consumed as transformer loss and from the magnetizing stream another small branch which magnetizes the core. Even at no load the transformer must receive these 2 small streams if it is active. Ordinarily both streams come from the same direction, that is, from the generator; but this is not essential, for when an induction generator drives a synchronous motor through the transformer the energy loss stream comes from the generator, the magnetization stream from the motor.

Walls for Coal Storage Bins

By H. E. Weightman

IT IS very important that every power plant using coal should be provided with a large storage capacity to insure a continuous supply of fuel during extended periods of bad weather, delays in transportation, strikes, etc., and also to permit taking advantage of low market rates. Coal-storage bunkers should be so arranged as to admit of the most economical methods for handling the coal, and a thoroughly reliable system of conveyors should be installed when the plant is sufficiently large to warrant the expense.

In designing a coal bunker, no fixed rule can be given as to its dimensions, except to make it as large as possible according to the space available. The approximate weights of coal per cubic foot are as follows:

Anthracite—

Buckwheat	55 lb. per cu. ft.
Pea	50 lb. per cu. ft.
Broken	60 lb. per cu. ft.
Bituminous	45 to 50 lb. per cu. ft.

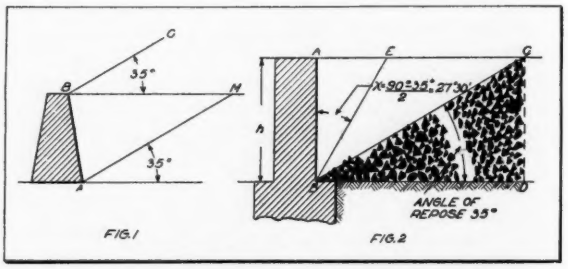


FIG. 1. REPOSE ANGLE OF BITUMINOUS COAL

FIG. 2. VOLUME SUPPORTED BY WALL

In designing the retaining wall for the bunker, it is, of course, necessary to know what the pressure of the coal will be on the wall. With a few preliminary remarks we can then attempt to determine this pressure. If bituminous coal is piled up, it will assume a slope of about 35 deg., or, in other words, its angle of repose is 35 deg. With anthracite coal, the angle of repose is 27 deg. For example, in Fig. 1, if A B represents a retaining wall for holding back bituminous coal, the coal will, if simply piled up, assume the slope A M. If the space is filled level with the top of the wall along the line B M, there will be a certain pressure exerted on each foot length of wall, due to the mass of coal A B M. If the coal is heaped up in the bunker until it assumes the slope B C, which is the maximum slope it can assume without running off, it is plain that the pressure exerted per lineal foot of the retaining wall, will be considerably greater than that when the surface of the coal was level.

Formulas and tables for obtaining the horizontal pressures exerted on retaining walls are based on Coulomb's theory of retaining walls. In this theory Coulomb assumes that the earth of an embankment held in place by a retaining wall tends to slide along a straight line or plane; that the center of pressure of the earth

acts at a point 1/3 of the height of the wall above the base: and that the line of pressure acts perpendicularly to the back of the wall. From these assumptions, he determined by reasoning and calculations that the maximum pressure on a vertical wall is not due to the weight of the prism, A B C, Fig. 2, but is caused by the wedge-shaped prism of material, A B E, which is included between the vertical back of the wall and the line, B E, that bisects the angle, A B C. The line, B C, forms an angle with the horizontal equal to the angle of repose of the material.*

For the busy engineer, tables are probably of more use than formulas. These are given herewith, showing total pressure per foot length of wall and the pressure per foot length on the bottom foot. These tables are from the Link-Belt Engineering Company's data.

TABLE I. HORIZONTAL PRESSURE EXERTED ON RETAINING WALLS BY BITUMINOUS COAL

BITUMINOUS					ANTHRACITE				
DEPTH IN FEET AB-FIG. 1	HORIZONTAL SURFACE BM-FIG. 1		SLOPING SURFACE BC-FIG. 1		DEPTH IN FEET AB-FIG. 1	HORIZONTAL SURFACE BM-FIG. 1		SLOPING SURFACE BC-FIG. 1	
	TOTAL PRESS. LB. PER LIN. FT.	PRESSURE ON LOWEST FOOT LB. PER LIN. FT.	TOTAL PRESS. LB. PER LIN. FT.	PRESSURE ON LOWEST FOOT LB. PER LIN. FT.		TOTAL PRESS. LB. PER LIN. FT.	PRESSURE ON LOWEST FOOT LB. PER LIN. FT.	TOTAL PRESS. LB. PER LIN. FT.	PRESSURE ON LOWEST FOOT LB. PER LIN. FT.
1	6.4	6.4	10	10	1	9.78	9.78	14.2	14.22
2	25	19	40	30	2	39.12	29.34	56.9	42.66
3	57	32	90	50	3	88.02	48.9	127.1	71.10
4	102	45	160	70	4	156.48	68.46	227.5	99.54
5	159	57	250	90	5	244.5	88.02	355.5	127.98
6	229	70	360	110	6	352.08	107.58	511.9	156.42
7	312	83	490	130	7	479.22	127.14	696.6	184.86
8	407	96	640	150	8	625.92	146.70	910.1	213.30
9	516	108	810	170	9	792.18	166.26	1151.8	241.74
10	637	121	1000	190	10	978.00	185.82	1422.0	270.18
11	770	134	1210	210	11	1183.38	205.38	1720.6	298.62
12	917	146	1440	230	12	1408.32	224.94	2047.7	327.06
13	1076	159	1690	250	13	1652.82	244.50	2403.2	355.50
14	1248	172	1960	270	14	1916.88	264.06	2787.1	383.94
15	1433	185	2250	290	15	2200.50	283.62	3199.5	412.38
16	1630	197	2560	310	16	2503.68	303.18	3640.3	440.82
17	1840	210	2890	330	17	2826.42	322.74	4109.6	469.26
18	2063	223	3240	350	18	3168.72	342.30	4607.3	497.70
19	2298	236	3610	370	19	3530.58	361.86	5133.4	526.14
20	2548	248	4000	390	20	3912.00	381.42	5688.0	554.58
21	2809	261	4410	410	21	4313.00	400.98	6271.0	583.26
22	3083	274	4840	430	22	4733.50	420.54	6882.5	611.46
23	3369	287	5290	450	23	5173.7	440.10	7522.5	639.90
24	3669	299	5760	470	24	5633.3	459.67	8190.7	668.35
25	3981	312	6250	490	25	6112.6	479.22	8887.5	696.79

Having determined the pressure back of the wall, we are in a position to design our wall. As the design of walls is now quite standardized and methods can be found in books, the reader is referred to them.

The most efficient wall is made of concrete and would probably cost from $6 to $13 per cu. yd., including labor, forms, contractors' profit, etc.

*From this the following formula was derived:

$$P = \frac{wh^2 \tan^2 x}{2}$$

where P=the total pressure normal to the back of a retaining wall per unit of length of wall, that is, per ft. of length of wall, w=the weight of the material per unit of volume, h=the height AB of the wall, x=the angle between the back of the wall and the slope of maximum pressure.

Foreign Development in the Power Plant Field

USE OF FERRO-COBALT INCREASES MAGNETIC DENSITY; WATER-COOLED MAGNET COILS RESULT IN THE PRODUCTION OF A FIELD OF 5000 GAUSS; IMPROVEMENTS IN ELECTRIC SOLDERING. BY J. H. BLAKEY

THE electro-magnet recently presented by the Societe des Amis du Museum to the Chair of Applied Physics and Natural Sciences of the University of Paris, has a weight of 1600 kg. (35,200 lb.) and a height of 1.60 m. (about 5 ft. 4 in.), and was given to the University for the purpose of assisting Mons. Bequerel in the investigations which have already made him famous. This magnet has been constructed according to the designs of Professor P. Weiss of the Polytechnicum of Zurich, who is considered at the present time as the foremost authority on matters relating to electro-magnetism. One of the recent discoveries which has been utilized in the building of this gigantic magnet is the fact that the compound Fe_2Co (ferro-cobalt) has a magnetic saturation 10 per cent higher than that of pure iron. But it was found that the ferro-cobalt industry was not at the time sufficiently developed to supply an amount of the material necessary to form the whole of the poles of the magnet, so the manufacturers had to content themselves with the insertion of a small piece at

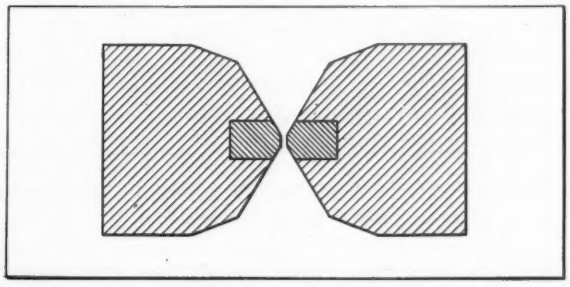


FIG. 1. SECTIONAL VIEW OF POLE PIECES WITH FERRO-COBALT TIPS

the extremity of each pole. This has been found to increase by 5 per cent the intensity of the field which can be produced before the point of magnetic saturation is reached.

Researches of Prof. Kamerlingh Onnes, of the University of Leyden, having shown the diminished resistance of conductors when kept at low temperature, provision has been made for the cooling of the coils by an inflow of cold water. The necessity for this is illustrated by the fact that when the magnet is being operated with the maximum current (200 amp.) a stream of water entering at 15 deg. C. under a head of over 100 ft. has reached a temperature of more than 50 deg. C. after passing through the coils. Under these conditions the magnet was producing a field of 48,020 gauss. As it would be necessary to increase the power in the proportion of 1 to 4 to produce a field of 49,990 gauss, and as, according to Joule's law, the heat developed is proportional to the square of the intensity of the current, it will be seen how important this matter of cooling is to the attainment of a strong magnetic field.

A short time ago, MM. Deslandres and Perrot reported to the French Academy of Sciences the results of experiments made by them in this line of investigation. They have tested several new types of electromagnets which differ from those in use heretofore for the production of intense fields, by their relatively small size and weight, by the arrangement of the coils in the plane of the space between the poles, and especially by the employment of higher currents than have hitherto been possible on account of their effective methods of cooling conductors and coils.

The results of their experiments may be summed up as follows:

They have, for the first time, realized a field of 50,000 gauss with a coil without iron. The gain due to the new methods of cooling has been 38,000 gauss, and the field is the highest of those yet observed in the direction of the lines of force. It is also more extended, the space included within the field being at least 100 times as great as the largest reached in previous experiments. In the case of these coils without iron, the observation of the direction of the lines of force, so difficult in the appliances previously used, and neglected for that reason, is extremely simple. The new method of cooling, formerly used with gasoline or benzine, is found to be still more effective with ordinary water.

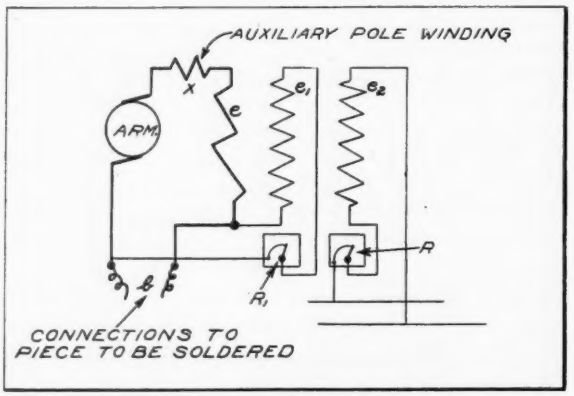


FIG. 2. DIAGRAM OF CONNECTIONS USED IN THE KRAMER PROCESS OF SOLDERING

The investigators express the belief that the field of 50,000 gauss which has been reached will be doubled or even tripled as the result of further experiments.

Improvements in Electrical Soldering

During the past few years, soldering by means of the electric arc has been put to many uses, such as the repairing of castings and boilers. In the original process, one pole of the generator is connected with a carbon electrode and the other to the piece to be soldered; when the operator touches the piece with the electrode, the current passes; when it is withdrawn to a small distance, an arc is produced, the heat of which melts the surface of the metal. In the Slavianoff process, the carbon electrode is replaced by a bar of metal of the same composition as the piece to be soldered; this melts gradually and becomes incorporated into the patch. In the Zerenei process, 2 carbon electrodes are inclined in relation to each other and suspended to an armature; the arc formed between them is brought to the piece to be soldered.

These 3 processes are based upon the employment of the continuous current; the arc requires tensions of from 45 to 65 v., and it is necessary to employ special dynamos because of the enormous variations of resistance due to the displacement of the electrodes. In the Kramer process, the intensity of the current is maintained constant, notwithstanding great variations of resistance, by means of a triple excitation, as shown in the accompanying connection diagram. One of the excitation windings is at e; the second, e_1, is mounted in derivation, and the third is branched upon a constant tension system. The intensity of the current required for the soldering is regulated by the rheostat R, acting upon the independent excitation; that of the machine is regulated by the rheostat R_1 acting upon the shunt winding. In consequence of this arrangement, the soldering current remains constant, even when the resistance varies as much as 0.5 of an ohm.

The Engineer and His Duty

ALL honor to the engineer whose watchword is Duty First. Here is another tribute to his calling, an inspiring testimonial ringing from Coast to Coast of his indomitable spirit in the performance of his duty, and showing his dependability regardless of circumstances and consequences.

Read this recent quotation from the daily press. A wonderful exhibit of endurance, bravery and determination is set forth, a conscientious and steadfast purpose of placing Duty First.

"Four men were killed, 4 seriously injured and 5 sustained minor hurts in a boiler explosion on the United States armored cruiser, San Diego, formerly the California, flagship of the Pacific fleet. The San Diego after the accident steamed into Guaymas. A wireless message from Capt. Robertson of the San Diego said that all of the men who were killed and injured had time to escape, but stuck to their posts in order to save the members of the engineer crew (government engineers aboard) in the compartment below."

If men are judged by what they do, how other can these brave engineers be judged but in terms of highest praise; men who stood by fearlessly in time of trouble and disaster, who stanchly upheld the honor of the engineer's calling at the cost of their lives.

At the recent session of the Tramways Association of Great Britain in Newcastle one of the speakers suggested the introduction of rubber or some other silent material for tires to street cars.

The speaker contended that a properly designed tire for street cars would exceed the life of tires on motor buses and motor wagons, on which a life of 20,000 miles and over was common; that the wear and tear on the rails would be reduced; that the cost of maintenance would be largely eliminated; and that the corrugation problem would be solved.

The question of doing away with noise and vibration, it was contended, was a strong argument in favor of rubber tires. A higher rate of speed could also be attained, which the speaker placed at 20 miles an hour.

Jeremiah Judson, C. E.

THEORY AND PRACTICE OF BLUFFING

"WHATCHA gonna do with 'em things?" queried "Windy" one day about 11:45, as he encountered Dutch coming down the shop with a box carefully divided into compartments each filled with a different sized washer, from a ⅜ to a 1-in.

"Me? Why Imagonner play a little game of poker at noon. Wanna git inter th' game?" replied Dutch, as he shifted the box to the other hip and crooked his ungainly form at a different skew to conform to the change in his equilibrium.

"Well, sure t'ing, Michael," replied Windy, as he laid the valve he was carrying, down on the bench, carefully selecting with unseeing eyes, a place already covered with miscellaneous scrap, instead of cleaning off a place. "I'm always partial to poker, for if there is one thing I can do better than another, it is to play poker. Where yuhgonner play?"

"Up in the '94'," said Dutch, shifting the box again, "slip over yer grub and climb up. Gottanough washers fer 'bout 8 fellers. Lotsa fun. Washers clink like real money and are exciting and nobody hain't losin' nothin'. Lots o' fun."

The noon whistle boomed out over the little town of Corlissville and before the steam had drifted off into space and disappeared, a number of fellows who were next, were seen climbing the steps and ladders to the top of a big pumping engine that was being erected for a southern city. The cylinders were 36, 63 and 94, by 60-in. stroke, and it was in the "94" that the mild form of the great American game was to be pulled off.

Soon the gang was seated around a bolt box in the center, each on a nail keg, with his back against the cylinder wall, and with a stack of washers in front of him, betting furiously as he glanced at the corners of his greasy cards from time to time to assure himself that "his hand was worth it."

Windy had been uniformly successful all along. Dutch and Ed Anderson had been "froze out" soon after the game started. Ed Brumby was about holding even, while Emil Lundgren was gradually losing "chips." Brumby dealt, and all drew cards. Emil raised and Windy came back with another stack of half-inch washers, confidently placing his cards face down on the box.

Windy was always quick to raise again, till one after the other dropped out leaving it all to Windy and Emil. Finally Emil threw up his hand—3 queens—in disgust, feeling sure that Windy had a full house or better. What was his disgust when Windy threw his hand into the discard to gather in the chips, displaying a single pair of fours!

"Bluffing," and all looked up to see Jerry Judson leaning on his elbows over the top of the cylinder as he stood on the wristplate stand, and completing the sentence with, "the house is pinched." Then he threw one leg over the edge and was soon on a vacant keg where he might look on.

"Did you ever see such bluffing?" said Emil, disgustedly, as he turned to Jerry, Windy meanwhile laughing at the cleverness of his stunt.

"Yes, once," replied Jerry, as he rubbed his chin and looked up at the 60-ton crane right over his head, and the gang, realizing that a story was coming, tacitly placed the washers in the box and gathered up the soiled and battered cards.

"When I was a young feller at the business, there came into the shop one day a feller that I stamped right away as a fourflusher, who looked like these Connecticut cartoons of an Arizone sheriff, big hat raked over one eye, heavy gray moustache, and a 'smart' swagger. All he needed to make him a hero in the movies was a cheap 6-shooter filled with blanks.

"Well, I happened to be near by when he bluffed up to old man Hoyer, then superintendent, and asked for a job. Boys, he put up the cleverest line of talk I ever heard, and Hoyer swallowed it all—bait, hook, line and pole. To hear him talk you would think he erected a 1000-hp. engine every morning before breakfast as an eye opener.

"Later on when it so happened that I was sent out to help unhusk him from his troubles, he confided to me that he never set up an engine in his life, never worked in an engine shop of any kind and never fixed an engine outside of a little 200-hp. one he ran in a small mill down in Arkansas, except that he once fixed up a dinky little engine on a merry-go-round that had been mistreated. He made a big bluff and got away with it." (And they all looked at Windy and smiled.)

"Would he go out on a job the first thing, or rather stay in the shop a few weeks or so to learn about the engine? Oh, no. The engine didn't bother him a bit. He knew all about it. So, on the strength of his bold front, he soldiered around the shop holding many interviews with Hoyer, mutually delightful, and around among the boys asking darn fool questions. You know, there is no one who can detect a poor mechanic like a good one. You might fool the boss and all that, but you can't fool the man who really knows.

"The Company made him a tool chest, as he claimed he lost his in a wreck a few weeks before with all his tools, and The Company also got him about everything that he called for, like a spoiled child, even to inside 'mikes' up to 36 in. and outside to 10 in. and a set of pipe and standard dies up to 2-in. pipe and 1-in. bolt, with taps. When he got it all together you would have thought he was traveling for a hardware firm. The boys just laughed.

"Oh yes, he had a name, but when addressed it was usually as 'Say,' etc., and among us he was known exclusively as 'the fourflusher.' Finally there was a big engine going to a rolling mill down near Pittsburgh—a big tandem, 40 by 76 by 60, along about there in size, with a 110-ton wheel in sections, and an outboard bearing with side wedges and back pieces that altogether weighed an even 40 tons. This outboard bearing was his first snag.

"The fourflusher arrived at the mill one day and ran his bluff on the mill people—and got away with it. He put in 3 days soldiering around the mill, looking over

the pile of iron that was to be an engine and overawing the bunch with his all impressive bluff.

"Then he proceeded to make a fatal blunder and do it in a systematic manner. As the engine was to be direct connected to the rolls, he thought the outboard bearing was the first thing to install, so he lugged it in place as he thought (but by what means he lined it up we never learned) *and then grouted it.*

"Then he hooked on to the main frame, a matter of some 65 tons or so, and lugged that onto the foundation and proceeded to line it up, but when he came to make the frame line with the outboard bearing, he discovered that to make it do so, would throw the back end of the frame so far out that the foundation bolt holes were 'blind,' and when you come to carry this back to the tail bearing behind a 76-in. low pressure and a 40-in. high, you can imagine that he was some up a stump for holes to put the foundation bolts in.

"What did he do? Oh, he bluffed up to the Company and told them that the design was faulty, and the foundation wrong, and partly got away with it. Anyway, the 'mistake department' was down around the erecting floor checking over the mate to the engine that was going to another mill, but could find nothing wrong with the design or the foundation blueprints.

"Well, the upshot of the matter was that your humble servant went down there as second man to Ed Baum, one of the best in the business. Ed took the day shift and I took the night shift, for the mill people were saying some awful things around there at the fourflusher's blunders.

"We had to tear things down, practically, and start all over again. As for the outboard bearing, we had to let that stay where it was and doctor it up. We put the main frame down where it belonged and lined it up with the rolls through the skewgeed outboard bearing, and noted the angle at which the outboard bearing jaws stood to the shaft after it was squared up with the frame and rolls. Then we planed the side shells off a little and replaced the parallel back pieces of this bearing with new ones planed at an angle so as to bring the bearing square with the shaft, even the heavy pedestal was grouted out of square.

"Finally we got ready to start up, and did so at 4:00 p.m. one day, and at 6 o'clock the first billet went through the rolls and the engine never stopped from then till morning during which time there was a man with a pail of oil and a dipper at each bearing, and a man at each hand oil pump. In 12 hr. we used 2 barrels of engine oil and one barrel of cylinder oil.

"So, leaving the fourflusher to look after the engine for a few days before turning it over to the purchaser, Ed and I hit the back track. Then things began to happen to the movie sheriff. To go back a little, when he first went on the job, he didn't do a thing the first few days but walk around the mill as if he were afraid to start something. If he saw a big monkeywrench, or a hand sledge or a bar or anything else that took his fancy, he 'allowed that he could use it in his business' and lugged it along to his bungalow chest.

"His bold front overawed the gang and he got away with the bluff. It is a long lane, however, that does not have a kink in it some place or other. And it so happened in this case.

"The mill boys kept tab on him and soon found that he was about done and diplomatically learned through one of the boys who volunteered to be the diplomat, that he was to leave on a certain day, in the near future. The diplomat basked in the sunshine of the fourflusher's thrilling narratives and marveled at the vast display of mechanical skill and knowledge, and was soon in possession of the fact that he was to pull out the very next day. This was what they wanted.

"The night before he was to leave, the bunch broke into his marvelous tool chest and appropriated everything he had and didn't leave him so much as a center punch. It's a poor rule that won't work both ways you know, and the boys not only got back their assortment of small stuff, but a little interest on the investment, as it were.

"How do I know? Well, it has been my pleasure to erect some engines in and around that same mill since, and the 'joke' was too good to keep. Did I ever lose any tools? Not so much as a drift pin. I found those boys around the mills the best you ever saw, if you give them credit for being made out of the same grade of clay as you are, and they will do anything in the world for you.

"But the fourflusher pulled off another 'winning streak' a month or two after that up at—Oh, there goes the five-minute whistle, so I guess the story will have to keep till tomorrow. Come, gather up those cards and washers and overboard with you, for it's a long ways to the floor," and the big "94" was deserted while the roar of the machinery starting up again filled the air.

Operating Troubles With Compressed Air

SOME CAUSES AND REMEDIES FOR TROUBLES WITH AIR COMPRESSORS AND PNEUMATIC TOOLS. BY H. A. JAHNKE

IN some manufacturing and other plants, when installing an air compressor, they use any old rusty pipe they may have in stock for the suction pipe as well as for conveying air to the tools. This is bad practice, as it will cause endless trouble and annoyance due to the fact that the scale and dirt will find its way through the pipe and hose to the tools, causing them to work badly or not at all; at times it is ruined.

SUCTION PIPE AND COVERING INLET

ANOTHER bad practice is that in some cases little attention is given to where the inlet of the suction pipe on air compressor is located. Should the compressor take air from a room where the air is filled with fine particles of grit, such as stone dust, such matter is constantly being drawn into the air cylinder, cutting this as well as the tools to which the compressor furnishes air.

USE NEW CLEAN PIPE

TO AVOID trouble, use new clean pipe on the suction of the air compressor, also for conveying air to the tools. Before connecting the pipes, they should be stood on end and hammered so as to jar loose any scale or dirt which may be in them; also, every fitting should be inspected to see that there is no scale or sand in it then,

after turning the air into the pipe, give each outlet a good blowing out so the pipe will be perfectly clean before connecting the hose and tool to the connection. By doing this, little trouble will be had with the tools later on.

Use Clean Air

Air for the compressor should never be taken from a room where the air is filled with fine particles of grit and other matter. The proper arrangement is to run the suction pipe through the roof or at least out of the building, then enclose the inlet in a wood framework, and cover this with layers of muslin or wire screen, to prevent particles of anything from being drawn into the suction inlet.

This calls to mind the following experience I had some time ago with an air compressor where the inlet was not carried with a wire screen or other material. This compressor is driven by steam. One day it was noticed that the air regulator, which is located in the suction pipe near the bottom of the air cylinder, did not work as it should. This air regulator works in conjunction with a steam regulator located near the throttle valve of the steam cylinder, the air regulator closing off the air while the steam regulator shuts off the steam. Then, after the air pressure lowers in the air receiver, the air regulator opens, which in turn opens the steam regulator, when the compressor runs full speed again. After shutting down the compressor and examining the air regulator, a shipping tag was found lodged in the regulator, which prevented this from operating. Someone had thrown this into the inlet, or the suction of the compressor had drawn it into the pipe. The inlet was covered at once by a wire screen.

Another case was that of a compressor where the valves had to be renewed quite often in the air cylinder. The trouble here was that the inlet of the suction pipe was near the floor of the room, when dust was constantly passing into the air cylinder, which caused rapid wear of the valves and piston. The expense of renewing the valves often would have paid for the pipe and labor to run the suction pipe somewhere outside of the building, many times.

Too Much Oil in Air Cylinder

Many air tools were sent in for repairs. In taking them apart it was nearly always found that the air passages were almost entirely closed up by some gumming matter. I was sure that the oil we were using in the tools and compressor was not the cause of the trouble. Then the hose was examined, when it was found that the rubber inside of this was very rotten, and this matter would work into the tools. The trouble here was that too much oil was used in the air cylinder of the compressor, which in turn had softened the rubber in the hose.

The air piston on a single straight line air compressor having 8-in. diameter steam cylinder and 8-in. diameter air cylinder by 8-in. stroke, would knock when running empty especially when there was not much air used for some time. In examining the air and piston cylinders several times nothing could be found wrong with the exception that there was a little more play between piston and cylinder wall than was necessary. The water cooling the air cylinder jacket was operated in a closed circuit, the water being used for other purposes after passing through the compressor. In thinking the matter over, I came to the conclusion that this was the cause of the trouble, as my idea was that when the compressor was running empty and water circulating through the jacket, it would cool the air cylinder to such an extent that the piston would contract quite a little, and since there was more play than necessary between cylinder wall and piston, the contraction of the piston would cause still more play when in turn the piston would knock against the cylinder wall. The valve controlling the water to the jacket was closed partly so as to allow just enough water to pass through the jacket to keep this cool, when in a short time the noise disappeared and has not been heard since. The valve wheel on the water controlling valve was marked. So the valve will be opened the same amount hereafter.

I may be mistaken in thinking that this cured the trouble; but why did the noise stop after this? Nothing was done to the air piston or cylinder.

Oil and Foundations

Replacing An Old Foundation Without Moving the Engine. By Receiver

That oil is detrimental to a brick foundation is generally admitted, yet one is surprised at the inattention given the subject in many plants.

When oil is allowed to find its way over the brickwork, it disintegrates the bond between the brick, and, as a result, the brick loosens, which diminishes the strength of the foundation as well as its life. Oil will also destroy the grout joint between the engine castings and foundation, with the result that the engine cannot be securely anchored in place.

A certain mill put in a new cross compound engine on a good brick foundation, and when all was installed, no protection was provided to keep the oil off the masonry. The engineer was one of those fellows that thought the greater portion of the engine load should be carried by the high pressure side. All went well for a while, when the oil loosened up the bond and the grout joint as well, so that the high-pressure side was soon sliding on its foundation, which assisted by the distribution of load between the cylinders, made matters worse, due to the greater thrust on that side.

Numerous attempts to tighten the anchor bolts resulted in breakage of these, although they were 1½ in. in diameter. The foundation was braced as shown in Fig. 1, in an attempt to stop the movement, a section of foundation by this time having broken away from the remainder. The results were disappointing to those in charge, since the engine moved as much as before. As things grew worse, it was decided to raise the weight of the engine off the foundation and rebuild it, and this was accomplished in the following manner with the engine running:

A heavy wall was built on each side of the foundation, as shown in Fig. 2. Then holes were cut in the original foundation and heavy I beams run across from new wall to new wall, with room to shim up to the bottom of the castings when required. As no toe jacks were

available, the floor was cut out and heavy cribbing laid with movers' jacks placed thereon to assist in raising the shaft. Another jack was located under the wheel to assist, too.

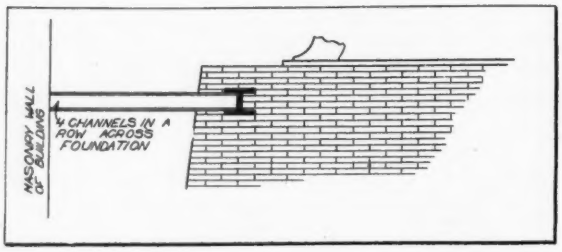


FIG. 1. METHOD OF BRACING FOUNDATION

I beams were cut and placed over and under the cylinder and end of guides, as shown, and united with heavy tie rods. These were, in turn, connected with I beams let into the wall to help hold the weight, when all were braced as shown.

Arrangements were made to have a zinc covering for the floor where the oil was thrown off by the moving parts, and the foundations given a heavy coat of good paint.

After running 2 weeks, all I beams were cut off where they overhung, and the suspensions removed. After 3 yr. of running under heavy overloads, the job is entirely satisfactory.

All foundations should be kept free from oil, the oil guards and floor being gone over with some form of roofers' plastic cement, and the foundations painted every 6 months.

U. S. Civil Service Commission announces an examination for marine engine draftsmen for submarines, on May 12 and 13, 1915. From the register of eligibles resulting from this examination certification will be made to fill a vacancy in the office of the Inspector of Machinery, Electric Boat Co., Groton, Conn., at a salary of $5.04 a day, and vacancies as they may occur in positions requiring similar qualifications at entrance salaries ranging from $4 to $5.04 a day. Applicants must have had an education of at least 2 yr. in engineering

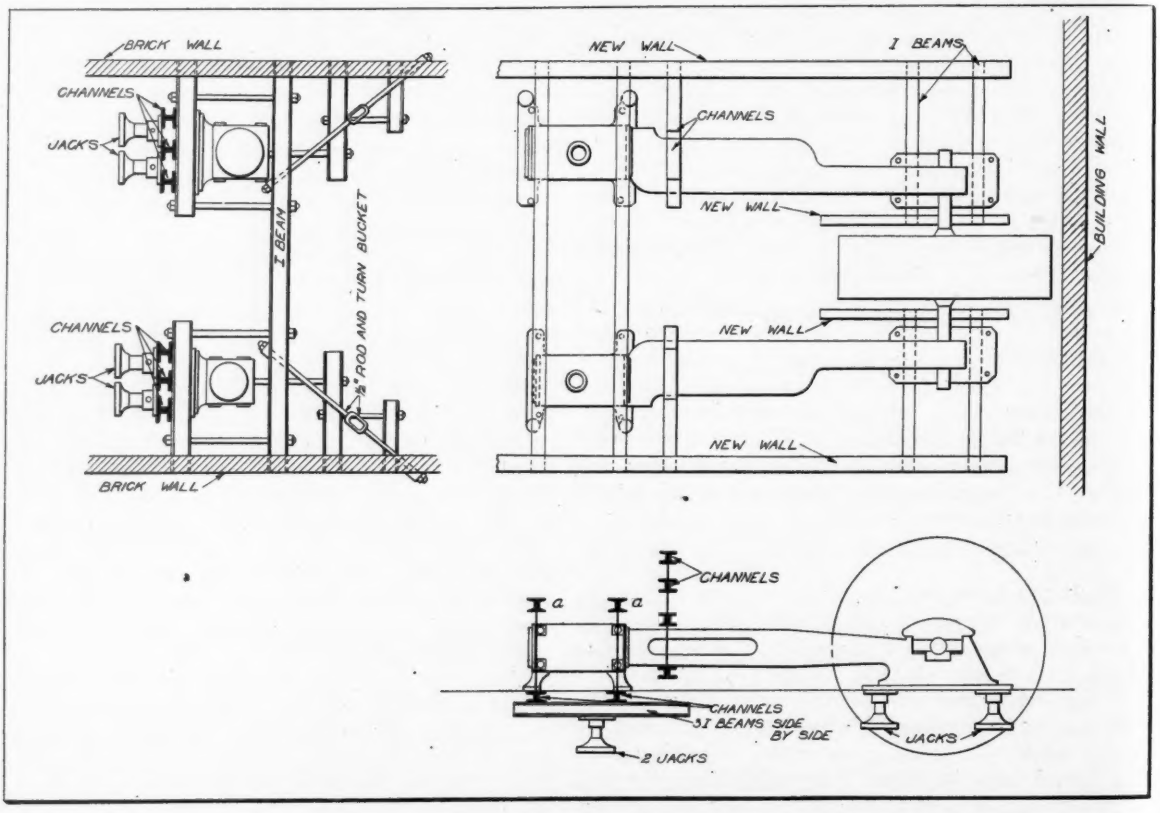


FIG. 2. PLAN AND ELEVATIONS SHOWING LOCATION OF NEW WALLS AND METHOD OF SECURING ENGINE FRAME

At this point, laborers were put to work cutting out the old foundation, and, as Christmas was coming, it was intended to make a 3 days' stop. The old material was removed, and, by working day and night shifts, the new foundation of concrete was placed. Then the engine was carefully lined and leveled up with jacks, some of which were buried in the new foundation, and engine grouted.

in a reputable technical school, and at least 2 yr. drafting experience; or 4 yr. suitable practical experience, of which at least 1 yr. must have been employed in office drafting. Experience in the design or construction of submarine machinery is necessary for eligibility. Persons who desire this examination, should at once apply for Form 1312, stating the title, Marine Engine Draftsman for Submarines (Male).

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Continuous Water Heater

IN CASES where floor space is limited, the type of water heater shown in the drawing, may be used to good advantage in that it may be suspended from the ceiling, or attached to a side wall. When properly installed it requires but little attention, and will supply a continuous stream of hot water to any amount within its capacity. The heater operates automatically by reason of the expansion and contraction of the brass pipes which extend through casings of ordinary pipe, and are connected to the manifold at the condensed steam outlet by the expanding process.

The manifold at this end is made in 2 parts, and bolted together, as shown. The outer part, at the top of which the cold water inlet is located, provides a settling chamber which can be blown out by means of the valve located on the bottom. This end of the heater when properly suspended is about 6 in. lower than the other, and if the proper device is used, the heater can be kept free of condensation.

At the end where the hot water outlet is located, the brass pipes pass through stuffing-boxes which are packed with ordinary fibrous packing. These should never be tightened more than enough to prevent leakage, in order that the heater may be free to move. This is an important point to bear in mind, for any movement of the heater causes a corresponding movement at the valve stem of the controlling valve, by means of the lever, one end of which is attached to the hot water outlet, and fulcrumed by means of a strip of flat iron clamped to the steam supply pipe. This lever is fulcrumed at F.

When cold, the brass pipes contract, and the position of the lever L is such that the opening in the controlling valve will be the greatest, and this is varied to suit the requirements of the heater by a regulating device located on the valve stem. By adjusting this, and the cold water supply, the temperature of the hot water can be nicely regulated.

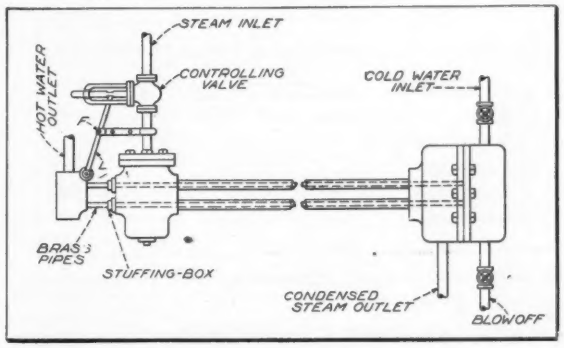
When steam is let in through the controlling valve it passes through the manifold into the outer pipes surrounding the brass pipes, and supplies the heat necessary to heat the water, the condensate passing off as previously described; as the water becomes heated it causes the brass pipes to expand. This movement is transmitted to the controlling valve, shutting off a part or the whole of the steam supply, depending on the temperature of the water.

In this connection a swing joint should be constructed of not less than 2 elbows and 2 nipples on the hot water outlet, in order to prevent any resistance to the brass pipes when expansion and contraction in these take place.

When the steam is taken direct from the boiler, the condensate may be returned directly to the boiler by means of the gravity principle. The usual check valve, with a gate valve located on the boiler side of the check must be provided.

When operating the heater in connection with a low-pressure heating system, the steam supply must be taken direct from the boiler in order to prevent as much as possible any drop in pressure at the heater.

When both exhaust and live steam are to be used, the usual practice in boiler connections should be carried out by using a reducing valve on the live steam pipe so that when exhaust is insufficient, live steam can be depended upon to operate the heater.



WATER HEATER WHICH CONTROLS TEMPERATURE AUTOMATICALLY

A check valve must be located in the cold water supply pipe, and a relief valve should be provided to protect the heater from accident in case the controlling valve should leak or become deranged so that it does not close tight.

Under these conditions, and with no water being drawn from the heater, the expansion of the water may be great enough to start the heater leaking, or cause some part of it to become broken. KARL HOFFMAN.

Pump Trouble; Stopping Leaks

I HAVE HAD a lot of trouble with a Marsh steam pump, 5½ by 3½ by 6 in., which would not run unless I stood over it and kept kicking the pilot valve.

I took it all apart; nothing seemed out of place. I put it together again, but it still refused to go. Then I thought that as it stuck on the piston end, the tube was worn or the nut in the steam piston needed tightening. In trying to get the nut off, I found my trouble; the steam piston was loose on the rod, and had worked so far off that there was not space enough to admit enough steam to move the pilot valve.

I tightened it up good and tight, put the head on and started up the pump. I have not had any trouble since.

I am working in a steam laundry; we have 2 steel 100-gal. soap tanks which leaked recently, but not now. I got some asbestos roofing cement. After drying out my tanks I coated all seams and holes, then I mixed about 50 lb. of pure cement with water, poured it in and let it set 2 days. That was about 10 months ago, and though they are in use every day, thère are no signs of a leak yet. A. N. R.

Automatic Condensation Discharge Trap

A SET of steam heating coils were continually giving trouble through freezing up, owing to lack of proper attention being given them through the night when the workmen were out of the shop. The coils were supplied from the boilers of a railway power plant with no return provision for the condensation, which consequently at frequent intervals, of course, had to be drained.

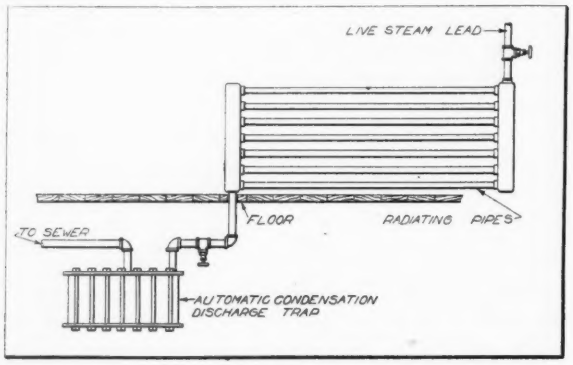


FIG. 1. CONNECTIONS OF HOMEMADE TRAP TO RADIATORS

The sketch shows how a condensation trap discharge was made out of 2 old 16-in. cylinder heads and a piece of discarded bushing about 10 in. long. The copper basin, on filling from condensation pouring over its top, took water to a point where its weight overcame the

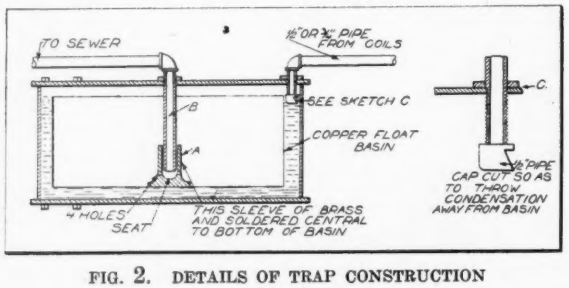


FIG. 2. DETAILS OF TRAP CONSTRUCTION

buoyancy of the water around it. The basin consequently sank a trifle and a goodly portion of the condensation shot up and out through the overflow, until the basin was again light enough to rise and shut off the escape.

The part or sleeve A is soldered directly in the center of the basin, and slips freely over the running nipple, B. The trap must be located where the discharge can take place in a sewer or other drain passage. As the whole arrangement is consequently full of hot condensate, it is almost impossible for it to freeze.

Heating coils which must be drained by hand, are always prone to freeze, through carelessness, and the device illustrated will automatically take care of a good many feet of radiating coil condensation.

F. W. BENTLEY.

Concrete Floor for Turbines

THREE YEARS ago the writer was employed to assist in the design of an electric light plant which was to be an extension of an existing pumping station. The size of the generator building had already been decided upon from a preliminary scale-drawing showing the machinery in place, and was to be about 60 ft. square inside of the basement walls. The boiler house was across a railroad track; connection to the generator house being made underground.

The drawings for the buildings were completed and construction was under way when the contracts for the turbo-generators and condensing equipment were let. There were to be installed immediately one 500 and one 1000-kw. turbo-generator and space was left for the future installation of another machine. In laying out the turbine foundations and condensing equipment on the basement plan, the data being obtained from the manufacturer's drawings, it was found impossible to locate the machinery in the allotted space. Here was a serious error. Construction of the building had progressed to a point that precluded a change; anyway, a change at that period would play hob with the engineer's reputation. To say that there was a lot of "blood-sweating," is stating it conservatively. The writer suggested a floor as the only way out of the difficulty, but was asked for a precedent and was able to furnish only the advertised statements of the manufacturers. We proceeded, however, to design a concrete floor to cover the basement, and with a row of columns down the center, the turbines would rest on a floor of 30 ft. span. The assumptions for loading were: dead load plus 100 per cent for dynamic stresses.

While the floor was being designed, the air about the office was full of expressions of fear regarding "synchronism of vibrations," etc.

When the drawings for the floor were completed, blueprints were sent to the manufacturers of the turbines that were to be installed and also to another manufacturer, with the idea of getting their opinions on the practicability of supporting turbines on a floor.

The answers might have been written by a single person, for they contained the same information, negative in its nature, viz.: "If the floor could be built sufficiently rigid to prevent vibration, it should answer the requirements," but they could not recommend placing turbines on a floor.

The floor was built and the turbines installed thereon. From the start, one of the machines gave trouble, which was attributed to lack of rigidity of the floor, but was found to be due to the machine running out of balance. This defect was remedied and the machines are now running satisfactorily.

On entering the generator house, one is greeted by a noisy hum which some call vibration, but which is really due to reverberation. The basement is a large chamber the length and breadth of the generator house, having a heavy concrete floor, and walls without openings, and with the generator floor acting like a sounding-board, the sound waves are echoed and re-echoed through the building. This trouble could be remedied by placing absorbent material on the walls and floor, but quiet is not sufficiently important to justify the expense.

That turbo-generators can be safely placed on a heavy concrete floor I do not doubt; in many cases it may be done with distinct economy, and in every case with the decided advantage of reduced space, allowing the condensing apparatus to be placed directly beneath the turbine. This gives plenty of room around the condensers.

C. O. SANDSTROM.

Indicator Rig for Ballwood Engine

THE ACCOMPANYING sketch shows an indicator rig which is furnished with the engines built by the Ridgway Engine Co., which is the best one I have ever used on an engine of the enclosed type. It consists of a shoe, A, which is bolted to the crosshead by 2 bolts. One of the holes in the shoe is oblong, by means of which the angle of the shoe may be adjusted as desired. Directly above this shoe, when it is at about midposition, a hole is bored and tapped in the engine frame, into which the standard, B, is screwed. This standard carries a shaft having a roller on the lower end and a bar at the upper end. The shaft is enclosed by a stiff spring, which, when the bar is released from the arm, P, which holds it up and out of contact with the shoe, allows the roller to ride on the

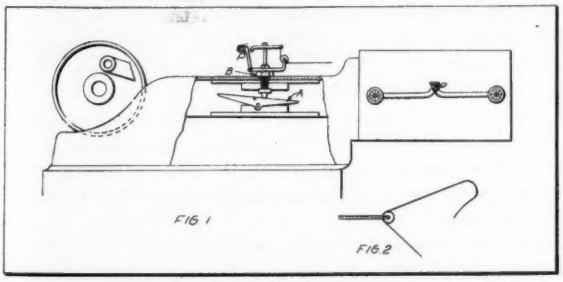


FIG. 1. INDICATOR RIG ATTACHED TO ENCLOSED TYPE ENGINE
FIG. 2. CONVENIENT HOOK FOR INDICATOR CORD

shoe. As the crosshead works back and forth, the shaft rises and falls with it. The indicator cord is connected to the end of the bar at the upper end of the shaft and passes around a pulley, thence to the indicator. As the movement of the shaft is vertical, the cord may be led in any direction from the pulley to the indicator, and will give a true proportion of the diagram to the movement of the crosshead. The yoke which carries the guide pulley and lever to throw the rig out of gear, may be turned by loosening the clamping nut, to bring the pulley in line with the indicator. The shoe may be adjusted to give a diagram of any length up to 3.75 in.

I believe that a rig of this kind could be used on L. F. B.'s engine, even though there is no opening at the side of the crosshead. If this rig is used, it will be necessary to drill and tap one hole in the center of the crosshead pin, and the second about 2 in. back and 3 in. below the other. In this last hole, a stud carrying a collar will be required to bring the bearing surface in line with the end of the crosshead pin.

On several occasions I have used a Z-shaped arm; but in using this arm, considerable oil is thrown on the floor, since the side plate must be left open. It should be made very rigid to prevent springing, and should be bolted to the crosshead with 2 bolts. With this arm, it is necessary to use an indicator which has a reducing wheel attached. In the rig shown above, no reducing wheel is used, as the movement of the shaft gives the proper length of diagram. When the arm is used on a high-speed engine, it is sometimes difficult to hook the cord on the pin when a plain hook is used. This trouble is eliminated by using the hook shown in Fig. 2, which should be made of stiff wire, and may readily be hooked or unhooked from the pin. To hook it to the pin, hold the ring part between the thumb and forefinger, carefully move the hand up to the pin as it reaches the back center, and as soon as the pin strikes the lower or straight part of the hook it will be moved down and back, which throws the upper part of the hook in line to catch the pin as it starts on the return stroke. To unhook, slide the hand up on the cord until it reaches the hook; as it reaches the back center, pull slightly sidewise and the hook will be released from the pin.

J. C. HAWKINS.

Manufacturers Should Welcome Criticism

I ONCE worked for a concern that advertised its product considerably. The product was good and was much used, but it was far from perfect, and the users knew it.

One of the papers in which this manufacturer advertised, opened its columns to its readers for discussion and the discussions often waxed hot and interesting. One of the readers, for instance, coldly criticised the manufacturer's product without mentioning any names. In my opinion, the reader told the truth, and I believe my opinion should be worth something, for I was employed by the manufacturer as an expert in the line of his product.

The manufacturer, however, didn't like the way the reader wrote. The reader produced data facts. So, instead of answering the reader with good, sound arguments, or, better still, with hard data, this manufacturer took a smash at the editor, saying that inasmuch as he, the manufacturer, was an advertiser in the paper, nothing should be said in that paper deleterious to his product.

I did not agree with the manufacturer at the time and do not agree yet. The paper stood firm and still stands firm, as far as I can see, in its policy to print the whole truth, regardless of whom it might hurt. Sometimes the paper hurts itself, temporarily, when the "hollering manufacturers" withdraw their advertising; but, in the long run, the truthful paper has come out on top.

This manufacturer's product is still good and is still being sold. It is, perhaps, better all around than any competing product; but it is not above criticism and never will be. No manufacturer should ever object to honest, frank criticism. He should be glad to know the user's troubles and then remove the cause.

N. G. NEAR.

Runaway Engines

In the plant where I am employed, a fan for the induced draft and fan engine are in the boiler room, a 50-hp. Corliss engine and a high-speed engine and dynamo for the lights in another room, a 250-hp. Corliss engine in a room some distance from the others, in a basement is a return pump for a drying and heating system, also the boiler feed pump.

One day I happened to be in the room with the 250-hp. Corliss, when suddenly the engine began to race. The load on this engine varied widely, and I thought at first that the load had been suddenly thrown off; but, as the engine kept speeding up, I shut the throttle off as soon as possible, and while it was getting back to normal speed I noticed that the crank end steam valve was not hooking up, which was proper action under extra high speed, but the head end valve was working full stroke.

On this engine the point of cutoff is controlled by a roller striking a projection on the cutoff cam, the position of which is controlled by the governor. The roller works on a pin that goes through the valve hook and is held in place by a thread on the pin, and a nut.

This nut on the head end was the cause of the trouble, as it had worked loose and came off, allowing the cutoff roller pin to work out of the hook; under these conditions, the governor could not control the head end valve, and the engine would take steam full stroke on the head end. Now, if the load on the engine is light enough to allow speeding up by taking steam full stroke on one end, the engine will surely "run away" if the steam is not shut off in a very short time.

In this instance, it was just chance that caused me to be in that particular engine room at the time, and if I had been looking after some other part of my work the engine would certainly have wrecked itself, or at least would have been going at a dangerous speed before I could have reached it and shut it off.

If you are operating an engine equipped with a device like the one described, I would strongly advise you to upset the end of the pin or prick punch the threads, thus making it impossible for the nut to work off. I have had 10 yr. experience running steam engines and never knew or read of a similar instance, and once is enough for me.

At another time, while running an engine making 200 r.p.m., with a throttling governor and belted to a dynamo, a short circuit occurred, throwing a heavy load on the machine. The belt squeaked and the engine staggered under the load for an instant, then began to race as the fuse let go and released the load. I was near the engine and shut the throttle off at once, but this did not check the speed. The governor had a lever on the outside with which the governor valve could be opened and closed, and I tried to shut the steam off by closing the valve, but could not close; then as a last resort, I pulled the valve open as far as possible and let it go back. After this, the engine came down to normal speed again, but nearly all the lights in the place were burned out, owing to the high voltage caused by the excessive speed.

An investigation showed that the composition disc was entirely gone from the throttle valve and a piece had caught in the governor valve and prevented it from closing, but pulling the valve wide open had let the piece go through into the steam chest where it was found with several other smaller ones.

Another "runaway" was a 6 by 6-in. engine running over 300 r.p.m., connected to a d.c. generator and equipped with a heavy inertia bar shaft governor. The load consisted of about 40 amp. of lights and a motor taking about 40 amp. When both lights and motor were on, the unit was working at its full capacity; but at this particular time, the lights were off and I had started up and was standing at the switchboard near the engine, waiting for the motor to be thrown on, so the engine was running under no load.

The starting resistance for the motor happened to be out of order and as the arm was moved over, no current flowed until the last point was reached when the motor was thrown directly across the line at full voltage with no resistance in circuit. This caused a heavy flow of current and a sudden heavy load to be thrown on the light running engine, which slackened the speed so suddenly that the governor bar struck the full stroke stops hard, and as the stops were bevel shaped, it wedged fast in this position. When the circuit breaker came out, the engine started to race, and before I could get the steam shut off I should judge that the engine was running at over double normal speed and was beginning to vibrate badly.

After many years of practical experience and considerable study in the steam engineering field, I strongly recommend that every steam engine in stationary practice be provided with a reliable speed limit stopping device that is independent of the regular governor and throttle valve and, in fact, I consider such a device in the engine room just as necessary as the safety valve in the boiler room, for neither is used under normal operating conditions, but for preventing disaster and danger in times of emergency.

To engineers who have charge of such equipment, I say take as good care of it as you do your safety valve and try it out occasionally to be sure that it is in good working order and can be depended upon in time of need.

One engine wrecked from overspeed will cost more in dollars than many engine stops, besides the danger to human life and limb. D. R. Johnson.

With Cass Gilbert, architect, as chairman, the special committee of experts appointed by the American Concrete Institute made a thorough investigation of the results of the fire at the Thomas A. Edison, Inc., plant at West Orange, N. J. The committee report stated in part:

"The fire fully demonstrated the advantages of monolithic structures. The fact that at 5 different places several of the wall columns were rendered useless and yet the upper portions of the building stood intact, is evidence of the superior merits of concrete in monolithic construction.

"The fused metal found in different parts of reinforced concrete buildings would seem to indicate that the fire reached an intensity of 1000 deg. F. in all these buildings, and in many cases as high as 2000 deg. F.

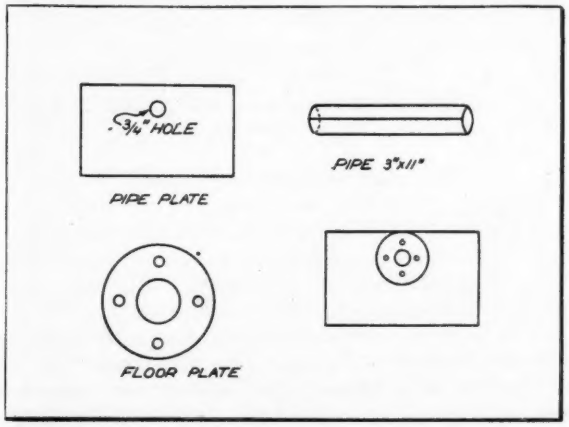
"In the greatest portion of these buildings the concrete remained firm and hard and intact after this severe heat treatment."

Successful Kinks From The Plant

For Saving Time, Work and Trouble

Homemade Hoe

I TOOK a piece of steam pipe 3 by 11 in., cut it along the seam and then heated it almost to a welding heat and straightened it out flat. I cut it off to make it 7 by 11 in. and then drilled a hole for a ¾-in. pipe tap and tapped it out. For a handle I used a piece of ¾-in. pipe with a long thread cut on it so that it would go through a ¾-in. floor flange, such as is used to



STEPS IN THE CONSTRUCTION OF A HOMEMADE HOE

fasten railings to floor. The flange was tapped out so the pipe would go through and screw into the plate. I put a rivet through the handle to keep it from turning in the plate, then riveted the 2 plates together with 4 rivets. Have used this hoe for a year and it is still in good condition. G. M. BROOKS.

Repairing a Step Bearing

FIGURE 1 SHOWS one of our 51-in. water wheels. A step bearing burned out lately, and the way a new one was put in may be interesting to readers. After the water is shut off, the flume emptied and the tail race pumped out, it is easy to jack up the wheel, from underneath, as high as it will go, with 4 jacks. This takes the weight off the step, A, Fig. 1.

The adjusting screws shown in Fig. 2 may be loosened and piece B removed, also bolts 1, 2, 3, 4. This will allow the bottom plate to be slipped from under the step and its collar and allow enough room for the step to be slipped from under the step shoe. The shoe should be well cleaned and sandpapered. The new step may now be put into the collar, the side bolts and set screw tightened, and the top of the step given a good coat of a mixture of graphite and tallow. The step and its collar may be put back under the step shoe, the bottom plate slipped back into place and the anchor bolts tightened down. The adjusting bolts can be put back to about the same place as they were at first, the jacks

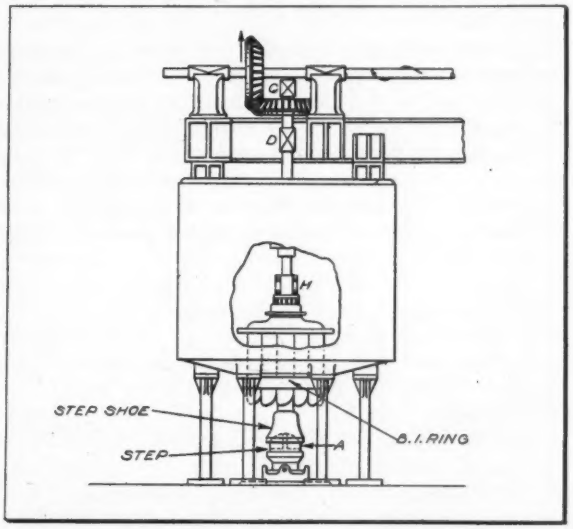


FIG. 1. VERTICAL WATER WHEEL WITH STEP BEARING

supporting the wheel may now be lowered and the step made to take the weight of the wheel. The next thing is to adjust the wheel vertically. The bolts in the top

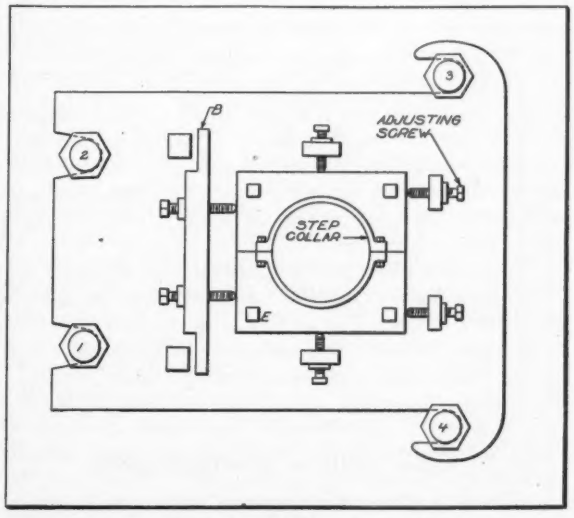


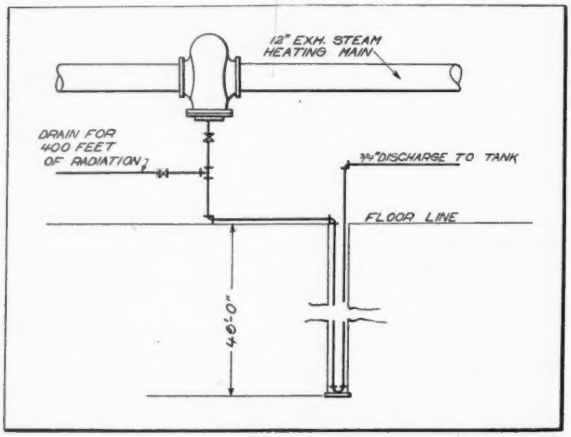
FIG. 2. BOTTOM PLATE OF STEP BEARING

bearings C and D are loosened and the shaft allowed to take its own place. If the gears do not mesh in enough, the shaft can be raised with the screws, E, Fig. 2.

A man inside the wheel can use a jack knife or a wedged-shaped piece of wood for a feeler, and feel around the ring; he can give orders which way to move the wheel to get it central, after which the check nuts may be tightened up, the split collar at H put down in its place, also bolts in bearings C and D tightened. The flume may be filled and the wheel started; sometimes it is necessary to adjust bearings C sidewise as the wheel crowds to one side when carrying the load. The holes through the step, as shown by the dotted lines at A, Fig. 1, allow water to enter between the step and step shoe. THOMAS SHEEHAN.

Water Seal Trap

A FEW DAYS ago, I visited my former chief, who operates a street railway lighting and heating station. As there had been quite a number of changes made in the way of apparatus in the station, I was much interested. Among the things I saw was a trap, of which the idea is old, but is seldom put to use. The condensation had to be removed from a 12-in. exhaust steam heating main, on which the maximum pressure reaches



CONNECTIONS TO LOOP TRAP

20 lb. As it was not practical to return the condensation to the feed water heaters, a 4-in. hole was bored into the ground 46 ft. deep, then he put down a 3½-in. pipe with a cap on the lower end. This gave him a dry well, into which he placed his trap, which is made of ¾-in. pipe.

The sketch shows how the connections are made. This trap also takes care of 400 ft. of radiation in the wash and locker rooms. The discharge is led into a tank and then piped through the wash and bath rooms, for the station help. The overflow from the tank is piped to the sewer. THEO. HUERTH.

Gasket Cutter; Double Valves

FIGURE 1 illustrates a gasket cutter which is easily made by cutting off one side of a divider and drilling in about ½ in. with a ⅛-in. drill. Make the cutter as shown in the sketch, of the end of a file and temper on the point to a straw color. It will work well if used in the right way.

B is a link which I use for getting the inside diameter of the gasket. Open the cutter, pull over the link and then close up the cutter to the size of the inside of the gasket and tighten screw A. Get the outside with the other part and divide by 2. I have used this for many years and would not be without one.

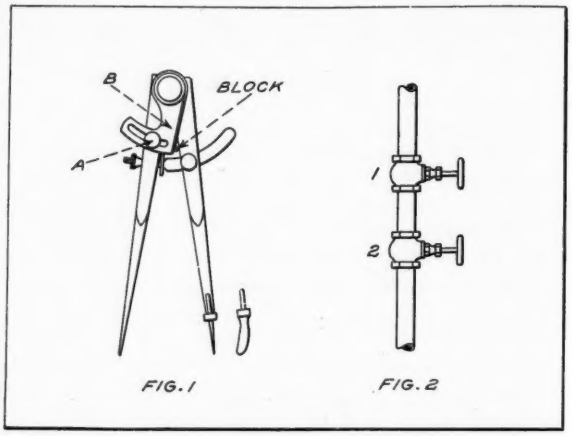
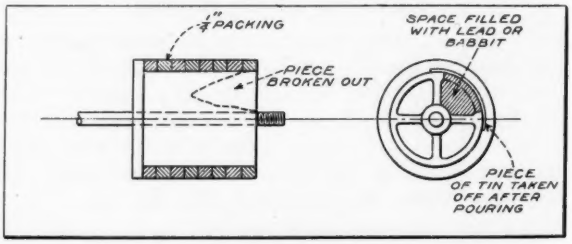


FIG. 1. CIRCULAR GASKET CUTTER
FIG. 2. DOUBLE VALVE ARRANGEMENT

I also believe in a double valve system, that is where one has to reach the valve, for instance in steam pumps and boiler feed pumps. By placing the valves as in Fig. 2, 1 is wide open and, used as a stop valve, remains in best condition, 2 is the regulating valve and becomes worn more or less. One will always find some old valves lying around which will answer the purpose of No. 2. A. L. JOHNSON.

Broken Piston

WE HAD an odd break in one of our house pumps last midsummer. A large piece broke out of one of the piston heads of a duplex pump. We then placed a strip of thin tin over the break and replaced it; but the packing worked out and the tin became jammed in between the head and the brass lining; it became



METHOD OF REPAIRING PISTON

necessary to use a sledge to back the head out. We then filled the opening in the head up with lead and babbit, and then repacked the pump and we have had no trouble with it since. It is an inside packed pump with about ¼-in. packing, and we have had trouble, unless it was drawn up tight. J. H. S.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Boiler and Engine Questions

How would you arrange the piping and valves for a battery of 3 boilers, each carrying a pressure of 100, 125 and 150 lb., respectively? These boilers supply one header, and all but the high-pressure unit are cut out at night.

2. Would it be safe to operate a boiler having the 2 bottom sheets corrugated from 1/16 to 3/8 in. in depth under a pressure of 80 lb.?

3. If, upon taking charge of a plant, you found one of the boilers had a small bag, would you continue to operate under a pressure of 120 lb.?

4. How much will a 6 by 16-ft. boiler expand?

How is sidewise expansion cared for at the front lugs?

5. What changes are necessary to make in the governor of a Corliss engine when changing from single to double eccentric?

6. If you had a double-eccentric engine of the Corliss type with the steam eccentric set 120 deg. ahead of the crank and the valves given a ¾ cutoff and negative lap, what would be done to the governor?

S. H. B.

Answers

As the pressures stipulated on the 3 boilers in your inquiry are 100, 125, and 150 lb., respectively, I take it for granted that this is the limit of pressure, or the safe working pressure. This being the case, one must positively guard against any of the boilers being subjected to a pressure greater than it will safely withstand. This can be done by using safety valves capable of discharging all the steam developed by the battery on the 100-lb. boiler, and on the 125-lb. boiler the valves should be able to care for all steam from the 125 and the 150-lb. boilers, or a nonreturn valve may be used on at least the 100 and 125-lb. boilers, and one can be used also on the 150-lb. boiler, if desired.

Of course, local conditions would determine somewhat the method of procedure in laying out a header to meet these conditions. Presuming that the 3 boilers numbered 1, 2 and 3 are set in one battery, or are side by side, and that the main header is supported on suitable brackets at the rear about on a level with the top of the boilers, I would suggest that each boiler be connected to the header by 2 90-deg. loops of not less than 6 diameters of the pipe in radius, these loops rising from the boiler and the header and meeting at about halfway between the 2.

At this point, arrange to have a gate valve of a grade sufficient to withstand safely the highest pressure, such as steel, ferro-steel or extra heavy cast iron, and also a nonreturn valve, these 2 being side by side and at the top of the loop, with the gate valve next the header and the nonreturn next to the boiler, arranged to permit steam to pass from the boiler into the header but not from the header back into any of the boilers. If the distance between the header and boiler is great enough, have a hanger or support under the valves. With this arrangement, there is absolutely no chance for condensation to accumulate in a dead end of the connection, as it must drain back into either the header or the boiler, and danger from water hammer is eliminated.

When the pressure on No. 3 is raised to 150 lb. at night, the other 2 boilers are automatically cut out of service by the nonreturn valves, provided the safety valves are properly set, but as a matter of general safety, the gate valves ought to be closed also.

Presuming that the demand for high-pressure steam at night is at the end nearest boiler No. 3, and that the header can be so arranged if size, etc., will permit, it would be an excellent plan to have a reliable valve between boilers 2 and 3, and closing this valve makes a high pressure line exclusively out of that end. The feed pump should be connected to the high-pressure end for obvious reasons, but should also be cross connected to the other 2 with suitable check valves a matter of preparedness for any emergency.

2. It would be the worst kind of a criminal act to operate any kind of a boiler, with the possible exception of a Scotch boiler built for a high pressure, with corrugations from 1/16 to 3/8 in. deep in the 2 bottom sheets, at 80 lb. pressure.

If these conditions are found to exist, it is easy to see that other defects equally bad, or worse, are possible, and one would be justified in refusing to handle the plant if the operation of the boiler was insisted upon.

A single pit, or several of them not close together, in the shell of a Scotch boiler, with a sheet an inch or more in thickness, might not be considered at all serious at the time, and the boiler continued in service at the usual pressure. The writer has seen a boiler of this type with the lower sheet pitted so as to reduce the original thickness as much as 40 per cent over a space of about 2 by 3 ft., yet when the explosion took place the rupture occurred at another place and the pitted portion remained intact.

3. On general principles, we would say no. Much depends upon local conditions and also the time of the week that you took charge of the boiler. A bag in a boiler is caused by scale or oil accumulating to such a thickness as to prevent the cooling influence of the water on the sheet, permitting it to become so hot and plastic that it readily yields to the internal pressure and bulges outward.

This action, in turn, causes the scale to crack enough so that the water can reach the sheet, thus cooling it.

This bag, however, acts as a ready receptacle for all manner of refuse that finds its way to the boiler and soon becomes full of foreign matter again to such an extent as to exclude the water from the sheet. This operation may or may not cause a rupture the second time it happens; but if one knew that the boiler was comparatively free from scale and the incident took place, say on Saturday, one might feel justified in pulling the load through for the rest of the day, but at a much lower pressure than the working pressure if conditions would warrant it. The condition of the outside of the boiler points strongly to the condition inside it.

4. The amount that a boiler expands in any direction depends on the temperature of the steam and the air. Wrought iron and steel will expand nearly 0.000,006,7 in. per ft. per deg. F. difference in temperature. Some grades run a little higher and some lower, down to 0.000,006,1. With a normal temperature of, say 70 deg. F., and steam at a pressure of 150 lb. per sq. in., which has a temperature of 366 deg. F., there is a difference of 290 deg. F. Multiplying this by 0.000,006,7 and by the length of the boiler, 16 ft., gives 0.31 in., or about ⅓ in. The same rule applies to the circumference; but, being taken on the circumference, the expansion across the boiler, or through the diameter, would be this amount divided by 3.1416, or for ordinary purposes, by 3, which is close enough for common use.

Of late years, the practice for suspending large tubular boilers in brick settings is by means of suspending links from overhead beams, with the brickwork set independent. It is only on the smaller sizes that they are allowed to rest on the brick work, in which case the lug rests directly upon a plate provided for the purpose, for the movement due to expansion is small. Medium sized boilers sometimes have rollers between the lug and the plate with the rollers set parallel with the axis of the boilers. Cast-iron balls are sometimes used.

5. Generally speaking, you would not have to make any changes to the governor. The knockoff levers would have to be remodeled somewhat so that the connecting pin would swing equally on both sides of the center line, and still cause the valves to close at all speeds. With a long-range Corliss gear, the lap of the steam valves in extreme position is much reduced over what the same size would be with a single eccentric standard gear, and the cam on the knockoff lever would have to be moved slightly to meet the new conditions. This, however, would not affect the governor as a general thing, on the type of gear usually found on most Corliss engines, although on some designs, it might be necessary to increase the length of the levers at the governor so as to obtain the right amount of travel at the knockoff cam without exceeding the proper range of movement of the governor. Should a case arrive where such a change is contemplated, it should be studied out with care, or the builder consulted.

6. The answer to the previous question is also applicable to this one so far as any change in the governor is concerned. Governors on Corliss engines are designed to have a certain range of "lift," that is, from their position on the safety stop or position of rest, to the highest point of the plane of rotation.

The distance between these 2 points is the lift, and the governor in going from one extreme to the other controls the speed, whether it be a single eccentric standard range gear, or a double eccentric long range gear.

If you had an engine with 2 eccentrics, with the steam eccentric set 120 deg. ahead of the crankpin, you have to all intents and purposes, the effect of a single eccentric engine, the only advantage being independence of adjustment between the steam and exhaust valves.

With the eccentric set this distance ahead of the crank, your limit of cutoff would be about 25 to 30 per cent, and if the eccentric be moved ahead to make the engine a long-range cutoff, the eccentric would be approximately 60 deg. ahead of the crank, in which case the range of cutoff would be about 65 to 70 deg. But, in order to change a standard range gear to a long range gear, the lap must be changed to negative lap, or at least line-and-line, all depending on the design. This reduces the lap in the extreme position (that is, with the wristplate in full throw and the valve closed, and hooked ready to lift) to just the amount to keep the valve steam tight.

In engines ranging from 12 to 24 in. in diameter, this will be about ¼ to 5/16 in.; but if the valve rods be adjusted so as to secure this small amount of lap, it will distort the steam lever and the drop lever to the point where their movements will be very erratic, so much so in some designs, that many parts will interfere and a wreck follow at the first revolution. So, in order to reduce the lap to the necessary amount for a long range, leave the steam and drop levers where they are for a short range gear, but draw the key in the valve stem and rotate the stem in the drop lever till you have the necessary amount of lap in the extreme position (or port opening in the central position) and scribe the stem for a new keyway. Generally this is not possible, as the amount of this rotation is so small that the keyways in the stem and in the drop lever do not move out of range of each other, in which case, turn the stem over, if the design will permit, or get new stems.

To get back to the governor proposition. Generally the knockoff rods form a right angle with the knockoff levers at one end and the governor levers at the other end when the governor is blocked up to about the running position, a distance which varies with different engines. This running position is that point where, if the governor were fixed and the engine started up, cutoff would take place at the most economical point, usually considered at from 22 to 25 per cent of the stroke, were all points of the gear properly adjusted. Then, with the governor in the running position, having adjusted the knockoff rods so that the angles are right, drop the governor on the safety pin or other device, and move the wristplate to the 2 extremes of travel, as shown by the travel marks. Here is where another important change takes place. The knockoff cam on the knockoff lever, will have to be relocated so that the valves will not carry in starting up, but will be tripped by the governor at all speeds.

On some makes of engine, this cam will require more movement than on others, while on a few engines, the cam and lever are cast integral, which prevents changing, but the position is found by calculation. In this case new levers must be secured from the makers; no changes were made in the governor.

G. H. Wallace.

Steam Turbine Questions

WHAT ADVANTAGES are claimed for steam turbines over reciprocating engines?

2. Give a brief description of any well known make of turbine.

3. How is the horsepower of a steam turbine usually measured?

4. What means are used in De Laval condensing turbines to give close regulation in governing?

5. What is the purpose of the vacuum valve in a De Laval condensing turbine?

6. What is the principal cause of loss of energy in steam turbines? I. S.

ANSWERS

SOME OF the advantages claimed for steam turbines as compared with reciprocating engines are as follows:

A higher speed and a more uniform angular velocity is obtainable, thus rendering these turbines more suitable for the driving of electric generators; less floor space; higher steam economy at all loads; less vibration of parts; less attention; less wear of parts; absence of oil in condensed steam; large overload capacity; smaller, and therefore cheaper foundations.

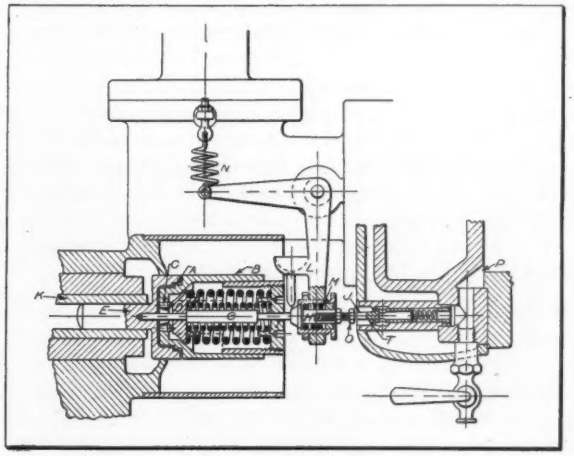
2. In the Jan. 1, 1913, issue of Practical Engineer, you will find descriptions of the various types of turbines found on the American market today, and on page 96 you will find the De Laval turbine described.

3. The horsepower of a steam turbine cannot be measured the same as that of a reciprocating engine. In order to determine the horsepower of this type of prime mover it is necessary either to use a Prony brake or else, in the case of an electrical generating set, to measure the electrical output of the generator. When employing this last mentioned method, the efficiency of the generator will have to be taken into consideration when calculating the horsepower which is being developed by the turbine.

One other, but not accurate, method of determining the horsepower of a turbine, is that of measuring the steam consumption by means of some form of steam flow meter. Knowing the number of pounds of steam being used, and also the steam required per horsepower-hour, it is a simple matter to find the number of horsepower being developed. The value of the number of pounds of steam per horsepower will have to be obtained by a previous test, or else the word of the manufacturers will have to be accepted.

4. The attached sketch gives the details of the governors and vacuum valves of a typical De Laval steam turbine.

Two weights, B, are pivoted on knife edges, A, with hardened pins, C, bearing on the spring seat, D. E is the governor body, fitted in the end of the gear wheel shaft, K, and has seats milled for the knife edges, A. The spring seat, D, is held against pins A by spiral concentric springs, the tension on which is adjusted by a milled nut, I. When the speed exceeds the normal, centrifugal force causes the weights to fly outward and overcome the resistance of the springs. This pushes pin G against the crank, L, which in turn closes the double-seated valve, thus throttling the supply of steam. To prevent racing in case the load is suddenly removed, the vacuum valve, T, is added to the governor mechanism. Its operation is as follows: The governor pin, G, actuates the plunger, H, under normal conditions without moving the plunger relative to the bell crank. In case the load is suddenly removed, centrifugal force pushes pin G against bell crank L until it reaches its extreme position and the valve is nearly closed and little steam enters the turbine. If this does not check the speed, plunger G overcomes the resistance of spring M, and H moves relative to L, and its adjustable projection, O, presses against valve stem T and allows air to rush into the turbine chamber through passage P.



DE LAVAL GOVERNOR

5. Answer to this question is contained in answer 4.

6. The principal sources of loss of energy in a steam turbine are: (1) Residual velocity for the kinetic energy, due to the velocity of the steam escaping from the turbine. (2) Friction and imperfect expansion of steam in the nozzles. (3) Windage, or friction, due to radiation of the wheel in the steam. (4) Friction of the steam traveling through the blades. (5) Shocks, impacts, eddies, etc., due to imperfect shape or roughness of blades. (6) Leakage around the ends of the blades or through the clearance spaces. (7) Shaft friction. (8) Radiation. O. H. H.

Reduced Steam Pressure in Absorption Plant

WE HAVE a 66-in. by 16-ft. horizontal tubular boiler, on which we carry 100 lb. steam pressure, and also a 2-flue boiler which we use only while cleaning the tubular boiler. Last year, the inspector allowed but 85 lb. steam pressure on the flue boiler, which thus reduced the capacity of our ice machine considerably. Now this year the inspector has reduced the pressure on the flue boiler to 65 lb. Is there any way that I can handle the ice machine and get the same output on 65 lb. steam pressure as on 100 lb?

We have a Columbus absorption machine of 18 tons capacity.

The main trouble in running on the reduced pressure is that we cannot generate enough gas to supply the required richness of liquor to maintain a low temperature in the expansion coils. Neither can we get enough distilled water to fill the ice cans. W. T. B.

A. When a boiler inspector reduces the pressure allowed on a boiler from 100 to 85 lb. in one year and then from 85 to 65 lb. the next year it should be considered sufficient reason to plan for the installation of a new boiler. Most likely the next time he comes he will further reduce the allowable pressure or condemn the boiler entirely.

To make as much ice when 65 instead of 100 lb. pressure is used will necessitate increasing the heating surface of the generator so that enough heat is supplied to generate enough ammonia to cause the desired amount of refrigeration.

The steam condensers will have to be supplied with live steam to give enough distilled water for the can filling.

It will not pay to make the changes in the plant to produce the rated capacity when only 65 lb. steam pressure is available. Make all the ice possible with the low-pressure boiler while cleaning the other till a new boiler is installed. This new installation will be absolutely necessary in a short time and had better be attended to now instead of spending money on any arrangement which will, at the best, prove temporary.

A. G. SOLOMON.

Why Safety Valve Seat is Beveled

IN LOOKING over the answer given by G. A. T. to the engine and boiler questions in the March 15 issue, it appears to me that question No. 6 could be answered much better if the Massachusetts Boiler Laws were not considered in the matter.

The fact that the Massachusetts laws state on page 8 of the rule book, "Seats and bearing surfaces of the valve disc must incline at an angle of 45 deg. to the center line of the spindle," does not explain why this form of construction is recommended.

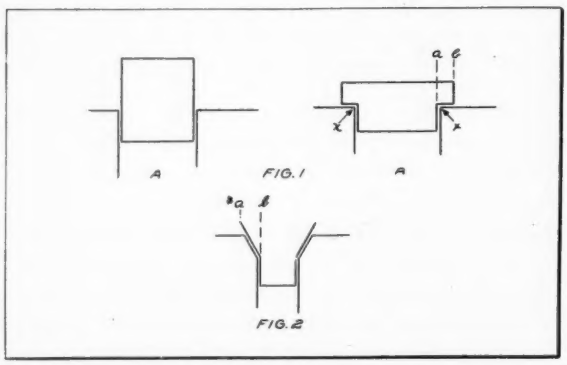


FIG. 1. FLAT SEAT VALVES WITHOUT AND WITH LAP
FIG. 2. BEVELED VALVE SEAT

About 2 yr. ago, I failed to pass a C. S. examination, and one of the questions to which I made a guess answer was, "Why should safety valve seats be beveled?" Later, I looked over all my books and papers, and asked this question of a number of engineers, but failed to get a satisfactory answer or explanation. As I am of an investigating turn of mind, I did not let the matter drop; so, in due time, I got the following answer, which in a practical manner covers the matter fully.

At the moment of release, the pressure acting upon the disc of the safety valve is at its maximum, and as soon as the valve opens the pressure will begin to fall. With a disc and seat made as at A, Fig. 1, the valve will open and close a number of times before the pressure will be reduced any great amount. Aside from the noise or clattering of the valve, the seat and disc would soon be worn out under this treatment. To overcome this, the additional area a, b, Fig. 1 B is given to flat seated valves. This additional area compensates for the drop in pressure, and the valve will stay open until the pressure is relieved. This form of construction is subject to one fault, excessive wear at the edge of the valve seat (x) Fig. 1 B. In time this results in a leaky valve.

In Fig. 2, the beveled or cone shaped seat and disc is shown. Here it will be noted the additional area is obtained without the sharp corner shown in the flat seated valve.

In summing up, it would seem that bevel valve seats and bearings are provided to give an additional area that the steam may act upon to compensate for the drop of pressure from the point of release, and to eliminate, as far as possible, the wear and cutting due to the action of the escaping steam. A. D. PALMER.

Adjustment of Relays

ON A G. E. Co.'s oil switch with double relays, there are on the bottom of each relay, the figures 5, 7, 9, representing, I suppose, seconds overload. Is it possible to set these relays to trip, at a certain amperage, as a circuit breaker? It is a 600-v., 300-amp. switch; relay plate is marked 5 amp. S.

A. Figures 5, 7, 9 do not indicate seconds overload, but amperes tripping current. This can be adjusted exactly as with a common circuit breaker. Apparently you are using a 300 to 5 current transformer. When 300 amp. pass through your circuit, 5 amp. flow through the secondary of your transformer and through the trip coil, a slight increase will, of course, trip the switch. If the switch is set at 7 amp., it will take 7/5 of 300 or 420 amp. to trip, etc.

In tripping mechanisms in which the time element enters in—such as in "time limit relays"—the time adjustment is merely a form of air dashpot—the air escaping through an adjustable orifice. By varying the rate of air escape, the breaker can be made to stay in for a second or 2. I do not believe any time limits act as slowly as 9 seconds; and I never saw any marked in any way to indicate the time. This has to be tested out, unless the setting is properly made at the factory.

V. E. JOHNSON.

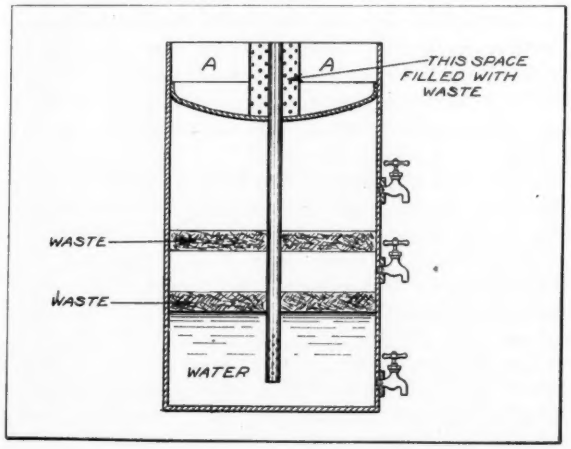
WHEREVER AN economizer is used in connection with or forming part of a boiler equipment, the controlling dampers should be so arranged that the gas passages around tubes of economizer cannot be wholly shut off from chimney connection during any time when boilers are in operation, and so that at least one passage will be open directly from the furnace to the chimney at all times.—A. S. M. E. Code.

Problems For Discussion By Readers

What Would You Do If You Had These Conditions To Meet?

Oil Filter Trouble

As I HAVE a large quantity of cylinder oil taken from elevators and oil extractors, which I did not care to throw away, I attempted to filter it in a filter of a design shown in the accompanying illustration. While the oil did pass through this filter, I found it moved exceedingly slow, so I decided to warm it, which I did by means of an electric heater placed in the tip of the filter at A. By varying the current flow, I was enabled to



CROSS-SECTIONAL VIEW OF OIL FILTER

obtain almost any degree of heat desired; but I found that, no matter how hot it became, the oil would continue to clog up the filter, which necessitated so frequent a change of the waste that the cost of waste and time spent in changing this would exceed the cost of new oil.

I wish the readers would tell me through these columns how I may filter this oil in a satisfactory manner.

JOHN H. ARMSTRONG.

Leakage Through Tunnel Walls; Boiler Treatment

IN THE Mar. 1 issue, J. C. H. asks how to stop leakage through tunnel walls. I have successfully stopped leaky cement cisterns, which were subject to constant expansion strains due to hot and cold water being alternately turned into them, not to mention periodical earthquake shocks. For this purpose, I used an elastic composition made of common pitch, with which was mixed, while hot, as much sand as the pitch will take without leaving voids. The object in adding the sand is 2-fold: First, pitch is more expensive than sand, and secondly, the pitch alone would tend to flow.

I would advise J. C. H. to give his tunnel walls a coat of this mixture, ½ in. thick, and back it up by 1½ in. of concrete. The pitch is an elastic substance, and needs something to hold it in place.

Now it is my turn to ask questions. Will someone tell me what success has been met with in using coal oil or gasoline as a boiler treatment, in order to remove grease from boilers? How much is required per horsepower? Are leaks caused by such treatment?

H. S.

Care of Boilers

IN ANSWER to F. O. B.'s inquiry on page 324 of the Mar. 15 issue, I would say that in the reserve boiler I would keep water level about 1 in. from the top of the glass. Then mix 10 or 15 lb. of soda ash in a pail of water and put it into boilers to prevent pitting and corrosion; be sure that the boiler is clean before you fill it with water; put on the manhole-plate so as to keep out all dirt, and so that you will be able to start up quick if something goes wrong with the other boiler.

If, due to any reason, you are losing water, put in more soda ash as you are putting in water.

Be sure that you have no leaks overhead, as this will cause external corrosion.

In the boiler you are running I would advise you to put 10 lb. of soda ash every time you shut it down for a Sunday; mix the soda with water and pump it into the boiler.

Keep the idle boiler clean outside and be sure that steam connection and feed valves are tight.

CHAS. MAGNUS.

Valve Setting

I CAN NOT agree with Mr. Wallace's answer to question 12, on page 369, of the April issue. He states that the travel and also the lead are fixed. Now, when the valve is actuated by either the Sweet or the Robb-Armstrong-Sweet governor, an overhanging pin is used in place of an eccentric. This pin is made an eccentric in itself, and is marked across the end to indicate its position. By turning this to right or left, the lead and also the travel may be changed.

H. H. JOHNSON.

Correction Note

ON PAGE 389 of the April 15 issue appeared a cut entitled, "Cross Section of Rotary Mixing Drum," which does not belong in the article, as it is a cross section of the Wendell Centrifugal Drier manufactured by the Link-Belt Co., and was intended for another article.

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Fire Protection

"An ounce of prevention is worth a pound of cure" is an old saying, which may well be applied when considering fire protection methods and equipment. We see erected on every hand large structures used to house thousands of dollars worth of inflammable materials and hundreds of human beings whose very existence may at any moment be threatened by the wrath of Vulcan, the God of fire. These modern structures are erected of "fireproof" materials throughout, and are often erroneously referred to as "fireproof" buildings. In the majority of cases, little or no attention is given the nature of the contents of the building, hence not only may these be readily consumed by fire, but they may become the source of a great conflagration, which the most modern methods of "fireproofing" cannot check.

It becomes imperative, therefore, that, even though a building be constructed of material in every sense of the word as nearly fireproof as modern methods can make them, ample protection be secured for materials and lives which are housed therein. Fire buckets, fire hose, fire extinguishers, and even well drilled fire departments, are maintained ready for instant use in many industrial establishments, schools, colleges, penal and charitable institutions, where the breaking out of a fire would jeopardize the lives of human beings, and result in loss of property.

Yet thorough as these precautions may be, they all depend upon the human element, and, as we know that to "err is human," we can understand why, frequently, a fire, though discovered early, has made great headway before the human element does or can respond. It is important, therefore, that some ever watchful and alert automatic device be employed which will, when affected by a rise in temperature, provide positive and instant means of extinguishing any blaze which may be created, without dependence upon the human element; and here comes in the modern sprinkler system.

Responsibility for the proper care and operation of such a system must naturally, in the majority of cases, fall upon the engineer, hence, it is of vital importance that he acquaint himself with its construction and proper manner of maintenance and operation, so that when the critical time arrives, no single detail of the system will fail, due to neglect or ignorance on the part of the custodian.

While there are 2 general types of sprinkler systems, the wet and the dry, each is of such simple construction and requires such little care in its upkeep, that there is no excuse for failure to act at the proper time.

A careful, regular inspection of the sprinkler heads, the piping, the valves, the alarms and the water supply, supplemented by frequent tests, will assure the man in charge that all is well.

Proposed Refrigeration Unit

As in all cases where there is no recognized standard unit of measurement, confusion and inconvenience are experienced in the refrigeration field when comparing performance or ratings of machines in different countries. Effort to overcome this has been inaugurated by a committee of the Institution of Mechanical Engineers, London, England, and its recommendation is

the use of the calory per second, but the proposition has many disadvantages, particularly as viewed from an American standpoint.

The calory is 3.9683 times the B.t.u., hence the calory per second gives 342,860 B.t.u. per day, whereas our Ton of Refrigeration is 248,000 B.t.u. a day, and a 50-ton machine would become one of 36 units under the proposed standard, a cut in rating that would cause confusion, and protest from manufacturers.

Argument for the proposed unit centers chiefly on adherence to the elements of the C. G. S. or metric system; but practical units of engineering,—volts, amperes, kg. per sq. c.m. have been based on practical rather than scientific considerations, and like attention to practical convenience and relation to existing standards would seem desirable in this instance.

It has been pointed out that the calory per minute would give a standard one-fiftieth of the "Ton of Refrigeration," which is most nearly a standard unit of anything now in use, with an error of less than one-half of one per cent, much less than the errors of observation that will appear in any test figures. This would make an easy conversion and comparison, but would not run into unwieldy figures even in large plants, since a 500-ton compressor would rate as a 25,000 unit machine on the proposed basis.

In determining the capacity of a plant, the conditions of suction and head pressures must be stated, and the latter depends on the temperature of cooling water available. In the committee recommendation the standard temperature was proposed as 59 deg. F., probably because this is the temperature at which the B.t.u. is now standardized. As a matter of practice, the cooling water, during a heavy ice-making season is seldom as low temperature as that, and it would seem more reasonable to establish the standard rating under average running conditions. Most plants have to deal with water up to 75 deg. and, in the southern plants, often as high as 85 or 90 deg. The common American practice of rating at 70 deg. as an average temperature would, therefore, seem better suited for a standard. It is to be hoped that common sense, and adjustment of standards to practical conditions will prevail in the future, rather than haphazard rules or overzeal for conformity to the elementary units and standards of pure science, which, usually have been chosen with laboratory conditions in mind.

A Proposed Franchise

In a contract before the Board of Estimate and Apportionment of the City of New York for consideration, the City is to purchase a stated amount of electric current from a central station for 50 yr. and in payment gives a franchise for a high-tension transmission line over the Catskill Aqueduct lands from the northern boundary of the city to the county line between Putnam and Westchester counties.

This particular contract is of local interest, but, unfortunately, there is a tendency to enter into such contracts in many localities, without considering the future consequences. The only certainty in the case is that the franchise will increase in value as time goes on, and long before the end of the contract period will probably be worth much more than anybody would now estimate. What the needs of the community will be in 50 yr. as to amount of current, location where the supply will be wanted and price of current, nobody can even guess. And granted that the terms as now standing are a fair equivalent of service for franchise, there are certain to arise many questions for argument, dispute and probably law suits.

The only safe course is to make a franchise agreement with definite payment, and subject to revision every 10 yr. as to the amount to be paid. Then let the municipality make a contract or contracts for such term as deemed wise, preferably not over 10 yr. at a reasonable rate for the service rendered. All parties will then receive a square deal and there will be no uncertainties and no contingencies will arise which cannot be met in a reasonable time. Swapping horses blind is not a good precedent for making municipal, any more than private contracts.

STATEMENT OF OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.

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Chas. Sanford Clarke, Sec'y.

Sworn to and subscribed before me this 23rd day of March, 1915. Warren A. Lathrop,
Notary Public.

[Seal.] (My commission expires October, 1918.)

P. S. BIEGLER, Associate in Electrical Engineering at the University of Illinois, recently assisted in the organization of a practical course in electrical testing for mine employes at Harrisburg, Ill.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

The Eckel Hydrostat

THIS feed water regulator is furnished in 4 different styles; namely, for single boiler control with float in the boiler, for series boiler control with float in the water column case and for series boiler control with float in the water column case.

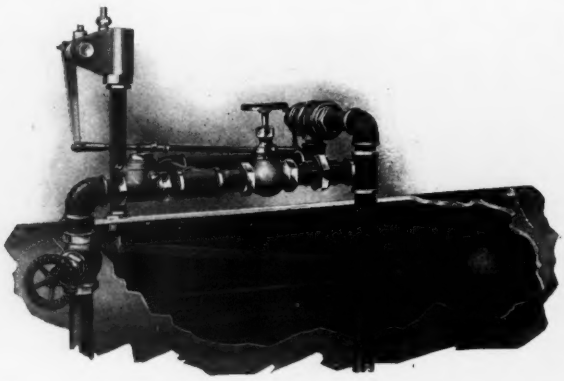


FIG. 1. ECKEL HYDROSTAT AS USED WHERE MORE THAN ONE BOILER IS FED BY THE SAME PUMP

In Fig. 1 are shown the details of construction of this hydrostat as used for series boiler control. As shown in the illustration, the float operates a vertical

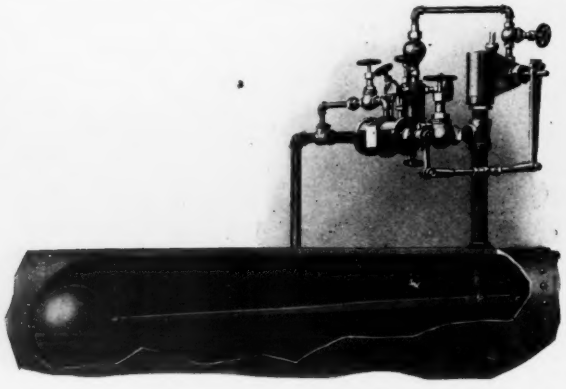


FIG. 3. ECKEL HYDROSTAT AS USED WITH SINGLE BOILER

rod encased in an upright supporting stand on top, and outside of the boiler shell. This rod passes through a stuffing-box and by means of a system of levers operates a control valve in the feed pipe.

The connections of the hydrostat and pump piping are shown in Fig. 2. The steam line of the pump is fitted with an automatic governor controlled by the pressure of the water at the water end of the pump. As the water rises in the boiler, the float operates the control valve on the water line, throttling the flow of water and thereby increasing the pressure in the water line between the pump and the valve. This increased pressure acts on the pump governor, throttles the steam and slows down the pump until the float again drops with the lowering of the water in the boiler and reduces the pressure in the water line by the opening of the feed

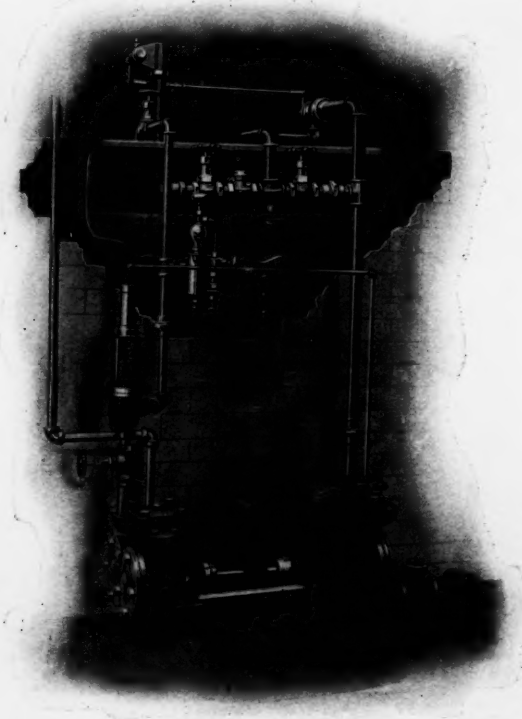


FIG. 2. HYDROSTAT AND FEED PUMP PIPING CONNECTIONS

valve. This in turn reduces the pressure on the governor, allows the pump to take more steam and work at a higher rate of speed.

The hydrostat used with a single boiler controls the pump speed and no pump governor is used in connection with it, as it is in itself a governor as well as a hydrostat.

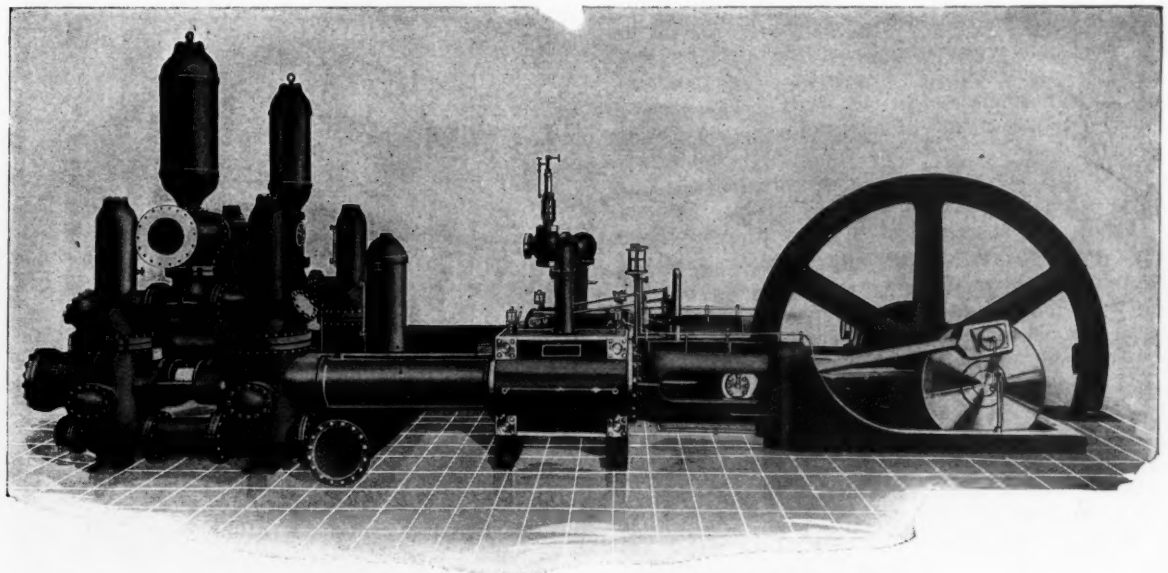
Eckel Hydrostats are manufactured by the Eckel Hydrostat Co., of Detroit, Mich.

Fisher Governors on Big Jobs

IN the accompanying illustration is shown an 8-in. type No. 1 Fisher governor installed on a 22 by 10 by 36-in. pumping engine manufactured by the Laidlaw-Dunn-Gordon plant of the International Steam Pump Co.

This outfit is working on the plantation of the Francisco Sugar Co., Francisco, Cuba, where it is operating hydraulically driven sugar centrifugals. Machines of this kind are in use in Cuba, Mexico, Philippine Islands and other countries. The service to which this apparatus is subjected is very severe, as the pressure and capacity in a sugar house varies constantly. The plants are run practically day and night for a period of from 6 to 8 months and require the highest grade of apparatus and controlling devices.

Fisher governors are made for all kinds of installations by The Fisher Governor Co., of Marshalltown, Ia.



FISHER GOVERNOR CONTROLLING LARGE PUMPING ENGINE

Individual Electric Lighting Plants for Steam

ONE of the problems which the Utah Copper Co. encountered in operating its steam shovels at night was to provide satisfactory illumination for them. A considerable number of these shovels must work on the night shift so as to maintain the large tonnage output required by the company's mills at Magna and Arthur.

The shovels work on terraces that have been cut in the side of the mountain and dig from a bank of hard porphyry. The bank in front of the shovel must be continuously loosened by heavy blasts, and these blasts scatter considerable rock in the vicinity of the shovels. Also rock from the upper terraces is often loosened and rolls down on to the lower terraces.

For night work adequate illumination is imperative,

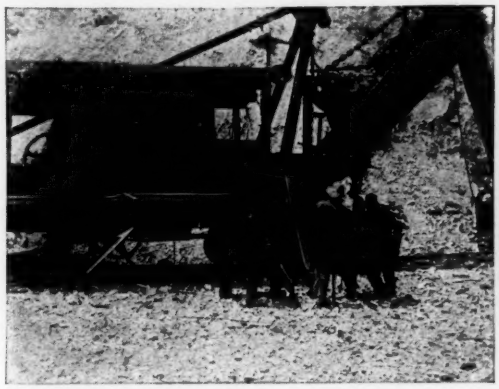


FIG. 1. LOCATION OF TURBO-GENERATOR UNDER SHOVEL

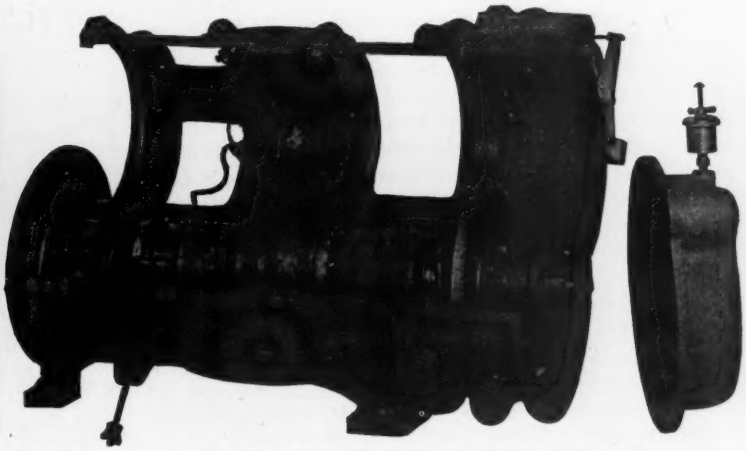


FIG. 2. INTERNAL VIEW OF TURBO-GENERATOR

not only for the bank from which the shovel digs, but also around the shovels themselves, to permit the necessary inspections and adjustments and to afford safety for the workmen. Acetylene had been tried for this work, but proved troublesome, costly and somewhat dangerous, so illumination by means of electricity was adopted.

The general illumination of the bank is furnished by a battery of powerful projector searchlights located on the opposite side of the canyon from which the shovels dig. To supply local illumination, about 20 incandescent lights were placed on each shovel, but to get current to them proved quite a problem. One of the difficulties was the fact that the shovels are in motion. A method was devised of mounting a reel on each shovel, which carried a semi-flexible cable that was unwound on to the ground as the shovel proceeded. One end of this cable was tapped onto a power circuit carried by poles. This arrangement gave considerable trouble during the several years it was in operation. Rocks rolling from one terrace to another would carry away wires or poles and blasts would frequently throw rock that would damage the semi-flexible cables along the ground. Not only were such accidents costly on account of the replacements required, but individual shovels were frequently put out of commission due to all lights going out when some rock disturbed by another shovel on a higher level crashed down through its feeder line.

The whole problem was one of considerable annoyance to the mine management until, in December, 1913, the Westinghouse Electric & Mfg. Co. furnished the Utah Copper Co. for trial one of its 1-kw. general utility turbo-generator outfits. This set was mounted directly on the shovel, being fastened to the under-side of the main shovel frame as shown in the accompanying illustration and was supplied with steam from the boiler furnishing steam to the shovel.

Upon the installation of this set no attempt was made to supply the shovel with any electric power other than that produced by the turbo-generator, and this shovel with its little self-contained power plant was immediately freed from all interruptions caused by accidents to its supply of illumination. The shovel made such a good record for itself that the company purchased the turbo outfit furnished on trial and about 4 months later ordered, for its other shovels that do most of the night work, 6 more outfits, which are now being installed.

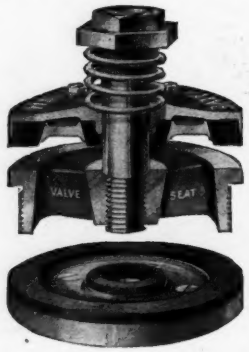
The turbo-generator outfits on these 7 shovels save the Utah Copper Co. about 50,000 ft. of No. 8 wire per year, which, however, is infinitesimal compared with the benefits derived due to the freedom of the shovels from delays in operation formerly caused by failure of the lighting system.

One of these sets will operate an arc lamp and a few incandescents at the same time, or about 40 25-w. incandescents alone. Practically no attention is required for the set because it is designed to operate for long periods without care.

Full rating is developed on steam pressures between 90 and 250 lb. A governor controls the speed and keeps it uniform. A fixed resistance furnishes voltage regulation and a rheostat is provided to adjust the voltage when the number of lamps in use is varied. Hence, in spite of the abrupt changes in steam pressure and load that characterize shovel service, steady light is obtained.

Hill Pump Valve

AN interesting arrangement of rubber rings for a pump valve is that shown in the sectional view herewith, made by the Hill Pump Valve Co., of 18 E. Kinzie St., Chicago. The rubber rings which bear on the valve seat faces are held firmly in position by metal forms, which keep them from spreading or getting out of shape, so that the only deterioration is the slight wear on the face, giving an extremely long life. Also, the rings and casings are so formed that the bearing is only on the inner and outer rings of the valve seat, thus avoiding any canting or holding up of the valve which might cause slippage or leakage. But 3 ribs are used in the seat, deeply undercut so that the water area is always large above the ribs, even when the valve is closed, thus permitting a quick start of the flow of water as the valve opens. The only wear comes on the rubber rings, and these can, of course, be quickly renewed when, after long service, such repair becomes necessary.



SECTIONAL VIEW OF HILL PUMP VALVE

Price Reductions in Edison Mazda Lamps

PRACTICALLY all the sizes and types of Edison Mazda multiple lamps are affected by reductions in list prices that were put into effect April 1, 1915, by the Edison Lamp Works of General Electric Co. On the regular straight side and round bulb lamps, from the 10-w. to the 250-w. sizes, also on sign lamps, stereopticon lamps, etc., the reductions range from 3 to 20c. per lamp, according to the size. These reductions, which average about 10 per cent, will tend to popularize further already popular lamps.

The new concentrated filament vacuum lamps of 25, 40 and 60-w. sizes now list at only 5c. per lamp more than the regular lamps of corresponding sizes.

On the gas-filled, multiple lamp of 100 to 1000-w. sizes, the reductions range from 50c. to $1 per lamp, the average reductions being between 20 and 25 per cent. The introduction of gas-filled lamps has been exceptionally rapid. Over a million are already in use. The decreased cost of these lamps will undoubtedly result in a still more rapid replacement of vacuum lamps by the more efficient gas-filled units.

Fluid Cling-Surface

MANY engineers who have treated their belts and ropes with Cling-Surface have regretted the necessity of heating it. To overcome this objection without impairing Cling-Surface efficiency has long been the aim of the Cling-Surface Co., of Buffalo, N. Y.

As now sold, however, Cling-Surface has been converted to a semi-fluid, ready for instant use at any temperature above 60 deg. In other words, no heating is required anywhere during 8 to 10 months of the year, nor in the winter if Cling-Surface is kept in warm rooms; where kept in a cold room or exposed to winter temperature, Cling-Surface need not be heated above 100 deg. F. (hand warm) and then only a few minutes for softening.

The improvement greatly simplifies application and its more extensive service. A 15 to 18-in. stick with a 2-in. strip of cloth secured to the end, dipped into Cling-Surface of ordinary house temperature, and the excess wiped off on the edge of the can, may be used to swab the face of the belt. The pulleys in turn distribute and work it into the belt fabric. Applications are repeated in this way until the belt is filled with the Cling-Surface, when further applications are required only at intervals.

News Notes

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS will hold a meeting in San Francisco, Sept. 21 to 22, for the discussion of papers and the study of features of interest at the Panama-Pacific Exposition.

THE COMMITTEE on Uniform Standard Specifications of the American Society of Mechanical Engineers is in receipt of numerous letters commenting on the value and thoroughness of the report on the Code of Practical Boiler Rules which has recently been published by the society. Two of the most significant letters which have been received are published below, and show that such a code has been in great need, and it is rapidly becoming the standard throughout the country.

"I am very pleased to receive your favor of the 3rd, enclosing a copy of Special Notice signed by H. V. Neff, and I shall take great pleasure in carrying out these recommendations to the letter. I will further state that all specifications furnished by us to our assured will conform to these standard specifications."

(Signed) London Guarantee & Accident Co., Ltd., By J. F. Sturgis, Supt. of Boiler Dept.

"I am very glad indeed to get your circular letter of the 31st, ult., and in reply will say that the State of Wisconsin will stand by the recommendations of your Committee to the fullest extent. We would be pleased to know the names of those manufacturers who have stated that in the future all their boilers would be made to correspond with the American Society Rules, regardless of whether they were required to do so by state legislation or not. We shall publish the list of these names in our literature in order to encourage the purchase of boilers from such manufacturers."

Industrial Commission, (Signed) J. D. Beck, Commissioner.

THE OHIO BRASS CO. announces that all prices on brass valves are withdrawn for the present on account of the advance in the raw material market. The new prices will be distributed as promptly as possible, and in the meantime inquiries will be promptly attended to.

THE TENTATIVE program arranged for the annual meeting of the National Gas Engine Association at La Salle Hotel, Chicago, June 23 and 24, includes the following addresses, reports and papers: "The Future Work of this Association," "The Data Work," Prof. P. S. Rose; Report of the Standardization Committee, Charles Kratsch, Chairman; Report of the Insurance Committee, S. M. Walker, Chairman; Report of the Cost Accounting Committee, C. B. Segner, Chairman; "Educating the Buyer to Your Type of Engine," H. G. Diefendorf; Report of the Committee on Legislature, H. W. Bolens, Chairman; "How Dealers May be Induced to Buy for Cash"; "Possibilities of the Farm Lighting Plant," Chas. H. Roth; Report of the Publicity Committee, H. W. Jones, Chairman; "The Magneto of the Future"; "What of the Kerosene Engine," Clarence E. Bement. A dinner (not a banquet) will be served in one of the private dining rooms, followed by election of 3 members to the Executive Committee; report of Special Committees, and a meeting of the Executive Committee. The meeting will close in time for those who wish to return home that night, to catch their train or sleeper. Arrangement will be made for accessory manufacturers to make an exhibit of their product. No charge will be made to members, but they should make arrangements in advance with the secretary, H. R. Brate, Lakemont, N. Y.

AN APPROPRIATION which will be sufficient to insure the advertising of "Electrical Prosperity Week" in every city and town in the country, was recommended by the "Electrical Prosperity Week" Committee, which met April 7, at the Engineers' Club, New York. This recommendation will be submitted to the Board of Directors of the Society for Electrical Development, for approval. The Board meeting was scheduled for April 19.

It is certain that the campaign will be the biggest trade movement of its kind in history. Offers of co-operation from leading electrical concerns and workers of the industry have inspired the leaders in the big campaign to put forth every effort to make it successful.

The Committee's recommendation as to plans carried with it an appropriation of $50,000 for special expenditures such as printing, and extraordinary expenses. In addition to this the Society will devote a large part of its regular appropriation to the work. This will make the Society's expenditures alone far above $100,000.

While the Society will handle the details of the big affair, and spend a large sum of money in carrying on the campaign, leading electrical manufacturers and jobbers have declared their intention of spending thousands of dollars in national publicity. Each company will tie its campaign in with the Society's great co-operative movement. Central stations, contractors and dealers will take advantage of the national campaign to obtain local results by handling sales campaigns of their own during the week.

The Committee definitely fixed the date of the week to be from Monday, Nov. 29, to Saturday, Dec. 4, 1915. This also met with the approval of the representatives of the various interests. It will furnish the impetus for a "shop early" sales campaign for Christmas electrical goods, and is particularly pleasing to the department store managers and merchants, for it gives them a chance to begin their extra illumination earlier and allows it to continue without a break until Christmas.

VOLUME III of the Transactions of the International Engineering Congress will comprise an important series of papers on the general subject of municipal engineering. The broad field will be treated under 9 topics covering the general subjects of city planning, streets, drainage, disposal of waste, water supply, protection against fire, transportation, public utilities and rural highways.

Approximately 20 papers are expected for this volume, prepared by authors representing 6 different countries. Of these papers, 2 may be mentioned by reason of their length and of the exhaustive character of the treatment. These are as follows: City Planning by Nelson P. Lewis; Traffic of London by Sir Albert Stanley.

The volume as a whole will be profusely illustrated with charts, diagrams and halftones, together with discussions contributed by leading American and foreign engineers, and will form a most valuable acquisition to the library of all engineers and others who may be interested in this phase of engineering work.

The transactions of the Congress as a whole will include from 7 to 9 other volumes, covering the various fields of engineering work.

Membership in the Congress with the privilege of purchasing any or all of the volumes of the proceedings is open to all interested in engineering work. For full particulars apply to W. A. Cattell, Secretary, 417 Foxcroft Bldg., San Francisco, Calif.

THE NAVY DEPARTMENT, Bureau of Supplies and Accounts, will receive bids on the following articles at Washington, D. C., until May 4th. Bidders interested should apply at once for particulars: Arc light carbons, silent chain drives, malleable iron pipe fittings, furnishing and installing oil indicators, induction motor, lard oil, pure sperm oil, pumping outfits, wrought pipe, plow steel, wire rope, switchboard, transformers, 2-in. malleable iron unions.

IN THE SUIT of the Terry Steam Turbine Co., of Hartford, to sustain the validity of its patent No. 741,385, Judge George H. Bingham of the United States Court for the District of Massachusetts at Boston, has handed down a decision sustaining the validity of the patent. It is sustained on the ground that Terry accomplished such a marked improvement in transforming the energy of the steam into mechanical power in an impulse turbine, that it was properly the subject of a patent which should be sustained. The judgment is also based on the fact that there was sufficient merit in the Terry invention so that the turbine immediately took a strong position in the commercial world, and maintained this for a period of 6 yr. before the alleged infringing device was introduced. The claim for infringement in the suit was sustained on the ground of resemblance of the details of the infringing machine to the Terry patent, the changes being merely those of form and not of principle.

The decision, therefore, sustains the fundamental patents of the Terry Steam Turbine Co. on the method of utilizing steam and the details of construction of its turbine wheel, and practically bars other firms from manufacturing similar devices.

U. S. CIVIL SERVICE COMMISSION is now advised by the Department of the Interior that as a result of requests for certification from the Bureau of Indian Affairs and from the Bureau of Mines and the resulting confusion in the minds of the public, it has developed that the examinations announced recently to fill the positions of oil and gas inspector, oil and gas inspector (well records), oil and gas inspector (mapping wells), and engineering inspector (oil and gas), can not be used to fill the position of oil and gas inspector in Oklahoma. These 4 examinations have therefore been canceled, and in their place the Commission announces an examination for oil and gas inspector to fill vacancies in the Department of the Interior for service in Oklahoma, by which 2 registers of eligibles will be established: Oil and gas inspector, grade 1, with salaries ranging from $2160 to $3300; and oil and gas inspector, grade 2, with salaries ranging from $1500 to $2160. Date of examination is May 18.

U. S. CIVIL SERVICE COMMISSION announces an examination for electrical expert aid (ship), on May 12, 1915, to fill a vacancy in the Department of Construction and Repair, Navy Yard, Washington, D. C., at a salary of $4 a day, and vacancies as they may occur in positions requiring similar qualifications at any United States navy yard or naval establishment. The following subjects will have the relative weights indicated: Mathematics and materials, 20; practical questions in electricity, 30; technical education and experience, 50. Duties require knowledge of all kinds of electrical apparatus used on board naval vessels, capability of preparing specifications and requisitions for electrical material for ships undergoing construction and repairs, making of tests of electrical auxiliaries in use on shipboard, and of estimating the time, material, and cost of making repairs of electrical equipment on ships; also, a general knowledge of the laws of electricity and magnetism and a practical knowledge of the design, construction and testing of dynamos, motors, electrical instruments, material and electrical auxiliaries used in the distribution and application of electric power on naval vessels, and compiling the results of such tests. Applicants must have had at least 3 yr. practical experience in electrical work. Graduation in electrical engineering from technical schools of recognized standing will be accepted as equivalent to 1½ yr. of this experience. Age, 23 yr. or over. Applicants must submit to the examiner on the day of the examination their photographs, taken within 2 yr. Apply for Form 1312, stating the title of the examination, Electrical Expert Aid—Ship (Male).

Books and Catalogs

OXY-ACETYLENE WELDING AND CUTTING, by Calvin F. Swingle; 190 pages, 76 illustrations; Chicago, 1915. Price, cloth, $1; leather, $1.50.

In the preparation of this book the author has apparently covered every practical point in the process of welding and cutting and the removal of carbon with oxygen. This little volume will therefore be well received by any and all who have aught to do with the oxy-acetylene process.

The various subjects covered are given in the following order: Welding, Welding Frames, Oxygen, Acetylene Gas Purification and Handling, Oxy-Acetylene Torches, Characteristics of Welding Torches, Welding Installations, Preheating and Annealing, Operation of Welding Installations, Metal Welding Practice, Oxy-Acetylene Cutting and Oxygen Carbon Removal.

TRILL, THE UNIVERSAL INDICATOR, is the title of an interesting 15-page bulletin issued by the Trill Indicator Co. of Corry, Pa.

This bulletin, which is a supplement to the above-mentioned company's Indicator Book, describes and illustrates the advantages and points of superiority of the Trill Indicator with faultless reducing wheel and cord take-up.

THE BUREAU OF THE CENSUS has just issued its third quinquennial report on Central Electric Light and Power Stations and Street and Electric Railways in the United States relating to the calendar year 1912. This report presents detailed statistics as to the development of the industries, output, equipment, finances, traffic, employes and salaries and wages, together with descriptive and analytical text. Numerous maps, diagrams and other illustrations are also given. An important and interesting feature is the inclusion of 2 articles by Thomas Commerford Martin, secretary of the National Electric Light Association, one discussing the recent developments and advances in the light and power station industry and the other dealing with street and electric railways.

Anyone desiring a copy of this report, which is a quarto volume of 450 pages, can obtain it by addressing the Director of the Census, Washington, D. C.

OIL-LESS BEARINGS is the title of a 48-page booklet recently issued by the Graphite Lubricating Co., of Bound Brook, N. J., describing Bound Brook bushings, bearings and washers and graphite impregnated Nigrum Bearings.

Nigrum Bearings consist of wooden bearings of any desired shape and size thoroughly impregnated with graphite so that the use of oils and grease may be entirely dispensed with.

With an ordinary steel shaft running in bronze or babbit lined bearings, either the shaft or the bearing must wear, resulting in the necessity of frequent repairs. With Nigrum Bearings, the wood being softer than the shaft, the hard particles of steel which are with bronze or babbit drawn between the shaft and bearing, are, by the friction of the shaft, imbedded in the bushing or bearing; the lubrication goes on just the same and the shaft is not cut.

Nigrum bearings are adaptable to grinding mills, flour mills, drug mills, textile machinery, printing presses, winding machines, loose pulleys, friction clutches and in fact wherever perfect lubrication with high speed is desired.

COMBUSTION ENGINEERING Corporation, 11 Broadway, New York City, is sending out Bulletin B-2 describing the company's Type "E" stoker.

CURTIS ENGINEERING SPECIALTIES manufactured by Julian d'Este Co., of Boston, Mass., are illustrated and described in the company's latest catalog.

MINIATURE CATALOG of Swartwout steam specialties made by The Ohio Blower Co., Cleveland, O., has just been received.

THE GLOBE automatic sprinkler system is discussed in 2 illustrated pamphlets lately published by The Globe Automatic Sprinkler Co., Cincinnati, O.

HERCULES FLOAT WORKS, Springfield, Mass., recently issued a new catalog and price list of Hercules seamless copper floats and air chambers.

A 20-PAGE BOOKLET, the latest publication of Armstrong Cork Co., Pittsburgh, Pa., on Nonpareil insulating brick for furnaces and ovens, has just been received.

IN THE MARCH 23RD issue of The Round-Up, published by the State College of Mexico, a very complete treatment is given of the work being done by the Engineering Department, with illustrations of the laboratories, the outdoor work, and a full statement of the new course in irrigation engineering. Reorganization of the entire school of engineering has recently taken place under Prof. A. F. Barnes, Dean of the College of Engineering, and courses are now offered in Mechanical, Electrical, Civil and Irrigation Engineering, leading to the degree of Bachelor of Science.

Trade Notes

THE STATE BOARD of Administration of Illinois has awarded to G. L. Simonds & Co., Chicago, the contract for installing 18 Vulcan soot cleaners on 18 new Keeler boilers to be installed in 4 of the State plants.

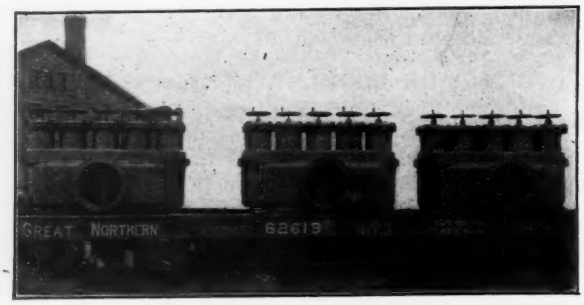
THE WRIGHT MFG. CO. has found that the increasing demand for its power plant specialties, which include alarm water columns, steam traps and exhaust heads, has necessitated additional space. With its allied companies, the Austin Separator Co., and the Murray Specialty Mfg. Co., it has, therefore, removed from the old address at 55 Woodbridge St. West to larger quarters at 97 Woodbridge St. West, Detroit, Mich., where it will have better facilities for the prompt filling of orders. A new and attractive catalog of the Murray automatic boiler feed regulator has just been issued, and is available on application.

THE PITTSBURGH Branch Office of The Bristol Co. has moved from 1670 Frick Annex into better quarters at 832 Frick Bldf., and the Pittsburgh District Manager, R. B. Anthony, has his headquarters there.

L. F. HAMILTON, in charge of the Advertising & Specialty Department of the National Tube Co., has returned from an extended business trip to the Pacific Coast in connection with the Exhibit at the Panama-Pacific Exposition. The National Tube Co. Exhibit is part of the U. S. Steel Corporation Exhibit which is located in the Mines and Metallurgy Building and occupies 44,000 sq. ft.—the largest single exhibit at the Exposition.

THE ACCOMPANYING illustration shows 3 of the large 30-in. Lagonda multiple strainers, which will be added to the present equipment of the Duquesne Light Co., Pittsburgh, Pa. With this latest installation, the plant will have a total of 8 30-in. Lagonda strainers.

These strainers are of the multiple straining basket type, each having 5 baskets. Four baskets are always in operation. With all 5 baskets in operation the effective straining area is over 3⅓ times that of the inlet or pipe line in which the strainer is installed. With one basket held in reserve or removed for cleaning, the



straining area of the 4 baskets in commission is over 2½ times the pipe section. The baskets can be removed for cleaning by operating the handwheel which raises the baskets into the cleaning chamber. The cover is then removed by loosening 3 bolts and the basket is lifted out in an upright position. This operation does not interfere in any way with the continuous operation of the strainer.

This company has also one 6-in., one 12-in. and one 14-in. strainer installed in its Rankin Station, and their thoroughly satisfactory operation has resulted in the latest order.

FOLLOWING are some recent shipments made by The Bruce-Macbeth Engine Co., Cleveland, O.: 2 250-hp. and 1 90-hp. gas engines, all direct connected to generators for use in the new office and exhibition building now being erected by The East Ohio Gas Co.; 1 90-hp. 4-cylinder natural gas engine to Kloss Ice Cream Co., Wheeling, W. Va.; 1 150-hp. natural gas engine, including Steam Process, to The McJunkin-Straight Dairy Co., Pittsburgh, Pa.; 1 90-hp. 4-cylinder natural gas engine to The Empire Marble Co., Cleveland; 1 90-hp. 4-cylinder artificial gas engine to The Broadway Market Co., Detroit, Mich.; 1 150-hp. natural gas engine to The Magnolia Petroleum Co., Fort Worth, Texas; 1 40-hp. natural gas engine to Alhambra Theater, Sandusky, O.; 1 200-hp. gasoline engine to New York Central Railroad Co. to be used on the Calumet River Lift Bridge at South Chicago, Ill.; 1 70-hp. natural gas engine to The O. Hummel Co., South Carnegie, Pa.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH

SEMI-MONTHLY

Subscription price in advance in the United States Mexico or united possessions, $1.00 a year.

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Foreign Countries, subscription price, $2.50 a year.

Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 So. Dearborn St., Chicago, Ill.

Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

ADVERTISING RATES

Display

Full page, one year, each insertion, $60.00.
Half page, one year, each insertion, $35.00.
Quarter page, one year, each insertion, $20.00
Eighth page, one year, each insertion, $12.00
Front cover, $150.00 per issue.

Other specified positions, regular rate plus 10 to 50 per cent.

Stippled plates used, but no heavy, black and white plates.

Classified Rates

Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,500

Technical Publishing Co.
537 S. Dearborn Street
Chicago

Position Wanted

POSITION WANTED—By engineer with years of experience in ice and electric light plants. Understand both a.c. and d.c. machines. Am a graduate of one of the best colleges in Middle West. A1 references. Ezra D. Dumas, Clarinda, Iowa. 5-1-1

POSITION WANTED—By I. C. S. student as oiler in a steam electric plant where there is a chance for advancement. Some experience with steam. Age 27. Address Frank Knapp, 404 So. Fifth St., St. Joseph, Mo. 5-1-1

POSITION WANTED—As chief engineer in a small or medium sized plant. Twelve years' practical and technical experience in operation and maintenance of steam, electric refrigerating, pumping and condensing equipment. First class license. Married; age 30. Employed. Address Practical Engineer, Box 392, Chicago, Ill. 4-1-3

POSITION WANTED—By young man with 10 years' practical experience from boiler room up. Hold first class Massachusetts engineer's license. Will go anywhere. Am total abstainer and can furnish A1 references. Address Practical Enginer, Box 393, Chicago, Ill. 4-15-2

POSITION WANTED—As assistant engineer; experienced; I. C. S. student; best references; strictly sober; hold first class license; will consider small salary if advanced as merited. Address Robert Pieper, Bloomington Prairie, Minn. 5-1-1

POSITION WANTED—By young man, age 21, as oiler or helper in power plant. A. S. C. graduate, electrical course. Some experience small gas engines. Would work a while for experience. Address O. W. House, Rush Springs, Okla 4-1-3

POSITION WANTED—By licensed engineer, age 30. Good mechanic. 10 yr. experience. Can furnish A No. 1 references. Chicago preferred. Address Box 390, Practical Engineer, Chicago, Ill. 4-1-3

POSITION WANTED—As engineer in a small plant or assistant in medium sized plant. Experienced with steam a.c. and d.c. machines. Member N. A. S. E. Strictly sober. Indiana preferred. Address G. A. Van Horn, La Fayette, Ind. 4-15-2

Wanted

WANTED—Resident subscription agents in the following cities: Atlanta, Ga., Cincinnati and Columbus, Ohio, Kansas City, Mo., Los Angeles, Calif., Louisville, Ky., Newark, N. J., New Orleans, La., Portland, Ore., St. Louis, Mo., San Francisco, Calif., Washington, D. C. This is an excellent chance for a hustler, who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

FREE ENGINEERING BOOKS and power plant tools and specialties for securing new subscribers to Practical Engineer. A dandy chance for the engineer with a little spare time to get some fine premiums. Send for free descriptive circular and terms. Address Practical Engineer, Subscription Department, Chicago, Ill. tf.

WANTED—Representatives to cover territory more thoroughly. Boiler room necessities. Liberal commissions. Old established house. Apply by letter. H. F. Maurel, 534 W. 22nd St., New York City. 4-1-3

WANTED—Engineer to sell automatic water regulators for steam boilers; can act as local agent; must be able to install. Eckel Hydrostat Co., 460 Mt. Elliott Ave., Detroit, Mich. 4-15-3

Help Wanted

WANTED—Agents on commission to sell our Shaking Grates. We will install grates on trial or put in on test at our expense with any grate made. Address Armstrong Mfg. Company, Springfield, Ohio. tf.

WANTED—Agents handling engine and boiler-room specialties in every section for side line paying large commissions. Give experience, line carried and territory covered. Address Practical Engineer, Box 381, Chicago, Ill. tf.

WANTED—Sales Engineer. Successful concern, established eighteen years, highest standing in its line in the United States, wants a Sales Engineer. Only first-class salesmen having had experience in engineer lines considered. Our product a necessity in every boiler plant. Price averages $250 per boiler. Sold on absolute guarantee. Exclusive territory allotted. Cash advances on trial orders will finance you if you have the ability. Positively give details about yourself in first letter. All correspondence held strictly confidential. Address Box 391, Practical Engineer, Chicago, Ill. tf.

For Sale

FOR SALE—Steam Hammer, 750-lb. Bement Niles; excellent condition. will sacrifice to move quick. Have large stock machinery of all kinds. Send us your inquiries. Zelnicker Supply Co., St. Louis, Mo. tf.

FOR SALE—Machinery. All sizes new and second-hand Pulleys, Belting, Shafting, Hangers, Couplings, Pillow Blocks, Collars, etc. Passman Bros., 28 and 30 So. Green St., Chicago, Ill. 3-15-6

MOTORS FOR SALE—Special type new guaranteed motors, 6 ¼-hp., 110-60 a.c., 2 1-hp. and 2 2-hp. 220-110-60 o.c. Also 2-hp., 3-hp. and 5-hp. 2 and 3-phase motors and direct current motors in sizes as large as 30 hp. A number of small generators, 5 light and larger. Fidelity Electric Co., Department "P," Lancaster, Pa. 5-1-2

Patents and Patent Attorneys

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Bldg., Washington, D. C. tf.

PATENTS THAT PROTECT AND PAY—Advice and books free. Highest references. Best results. Promptness assured. Send sketch or model for search. Watson E. Coleman, Patent Lawyer, 624 F St., Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had, and the exact costs. Send for full information. tf.

PATENTS—Send sketch for free search and report. Books on patents and book of reference letters sent free. John S. Duffie & Co., 612 F St., Washington, D. C. tf.

A. P. CONNOR, consulting electrical and mechanical engineer, attorney-at-law and solicitor of patents and trademarks, 121 Carroll St. S. E., Washington, D. C. tf.-x.

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Educational and Instruction

ENGINEERS' POCKET MANUEL, 175 pages, edited by University of Tennessee, will be mailed every subscriber sending in NEW subscriptions (not your own) to Practical Engineer. Gilt edges; bound in leather.

Miscellaneous

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill. tf.

Sparks From The Advertising Pages

BUSINESS INSURANCE

Most men of the commercial world know the value of insurance against loss by fire — but there are a few who do not yet realize the importance of advertising as insurance against loss of profits.

Indeed, advertising in itself constitutes business insurance.

This is well illustrated in the recent statement made by President Wooley of the American Radiator Co. "Advertising," he says, "has brought a record amount of business to the company, and the business has developed in a measure consistent with the company's ability to give the broadest publicity to the advantage which it offers in its products."

It is Mr. Louis Bruch, the advertising manager, who defines advertising as "business insurance."

At first the company advertised to gain prestige, but in 1907 when financial distress swept the country, it realized the tremendous possibilities of advertising as business insurance. Putting into practice the theory that the time to advertise is when business is dull, an elaborate and extensive advertising campaign was inaugurated with the result that advertising was viewed in a different aspect — not alone as a creator of good-will and as an encouragement to greater prestige, but as an actual result-getter.

The sales for 1908 showed a heavy increase over those for the preceding year. The policy was continued and each succeeding year more business insurance was carried, bringing greater results, until last year, admittedly an "off" year for business — the company reports a net profit of $2,289,750.

There's a lesson behind this experience of the American Radiator Co. — a lesson to manufacturers — a lesson to the readers of Practical Engineer.

Suppose the above mentioned company had not adopted the policy that called for publicity — had not planned work of promotion — had waited until the troublesome affairs, which are inherently individual and not general, resumed their normal state — had suspended operation until the hard-time harper had exhausted himself — they surely could not have reported the heavy increase in profits which Mr. Wooley agrees was due to the broad publicity given their products.

The interruption of the work of promotion would have been detrimental to development, and the buyer, the man who must follow advertising would not have had the benefits of improvements on the product for sale — of a lower price due to advertising — of the many advantages resulting from successful marketing. He would have been justified in believing there had arisen a lapse of interest within the organization — something wrong inside that would eventually be felt outside and among the company's patrons, or he would be suspicious of mismanagement or even total dissolution of business.

Patronize the man who advertises, for advertising is your business barometer indicating the activity and progress of the manufacturer and the success of the equipment he has to offer.